



***Development of an Enterprise Resource Planning Systems  
(ERP) Adoption Model in Higher Education Institutions***

**A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of  
Doctor of Philosophy**

**at the**

**University of Bolton**

**by**

**Mohammed Albarghouthi**

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## **ACKNOWLEDGEMENTS**

First and foremost, I would like to express my sincere gratitude and appreciation to Dr Baomin Qi – who supervised this research – for her encouragement, for her wide knowledge and for her logical way of thinking in guiding me throughout my research. This research would not have been completed without her valuable support. I would also like to thank her for her suggestions, information and reviews of the drafts of this research.

My sincere appreciation also goes to my external supervisor, Dr Muneer Abbad, for his valued comments and all he has done for me during the research process.

This thesis is dedicated to my daughters – Cileen, Lana and Rose. My sincere appreciation also goes to my wife, Esraa Sweidan, for her valued comments and all she has done for me during the research process.

It is difficult for me to adequately express my gratitude to my parents who never ceased praying for me and wishing me every success. My heartfelt thanks also go to my brothers and sisters, who showed concern for my studies and health, and to my friends in Jordan and England. I thank them all and pray that God will keep them safe.

## **ABSTRACT**

This research investigates and identifies some of the major factors affecting the adoption of Enterprise Resource Planning (ERP) systems by Higher Education Institutions (HEIs) in Saudi Arabia. ERP has become a significant computer system in organisations; therefore, this study was motivated by the lack of comprehensive research on the adoption of ERP systems by HEIs.

The present study has extended previous research by examining factors that may affect the adoption of ERP systems, based on the Technology Acceptance Model (TAM). HEIs must utilise information systems to achieve a competitive advantage; therefore, extra knowledge of the factors that affect their adoption is required to understand and facilitate acceptance.

The study employed a quantitative approach and was conducted on six HEIs located in different cities in Saudi Arabia. The proposed model was validated by a survey of 394 ERP users and was estimated using Structural Equation Modelling (SEM). A path model was developed to analyse the relationships between the factors in order to explain the adoption of ERP systems by HEIs. The results have shown that both organisational factors (top management support and user training) and individual factors (computer self-efficacy and computer anxiety) have significant effects on ERP adoption in HEIs.

The current study provides both theoretical and practical contributions. The development of a new model extends the body of knowledge of the existing literature and research related to technology acceptance and, more specifically, to the adoption of ERP by HEIs. Along with these academic contributions, practical contributions are anticipated from this current study because HEIs need to enhance performance in the current competitive setting. This conceptual basis is aimed at providing an insight on the possible management procedures and activities that managers might utilise for examining the complexity of the ERP, thus equipping them with an instrument for exploiting its potential. This is critical

because HEIs face challenges when applying ERPs through mechanisms that enable them produce the anticipated benefits.

This research also provides useful insights into the relationship between the factors and the actual use of ERP systems, enabling the HEI adoption teams and technology developers to better understand the key determinants of user acceptance and how different decisions may influence the success of the new systems they produce. Therefore, the proposed model serves as a framework for thinking through and establishing the different requirements and development criteria for the new system.

## **DECLARATION**

This dissertation is an original and authentic piece of work by myself. I have fully acknowledged and referenced all secondary resources used. It has not been presented in whole or in part for assignment elsewhere. I have read the Examination Regulations and I am fully aware of the potential consequences of any breach of them.

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## LIST OF ABBREVIATIONS

A	Attitude
$\sqrt{\text{AVE}}$	Square Root of the Average Variance Extracted
AGFI	Adjusted Goodness-of-Fit Index
AMOS	Analysis of Moment Structures
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
B	Behaviour
BI	Individual's Behavioural Intention
CA	Computer Anxiety
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Composite Reliability
CSE	Computer Self-efficacy
CSF	Critical Success Factor
Df	Degrees of Freedom
DSS	Decision Support System
DTPB	Decomposed Theory of Planned Behaviour
EDI	Electronic Data Interchange
EFA	Exploratory Factor Analysis
ERP	Enterprise Resource Planning
EUC	End-user Computing
FA	Factors Analysis
GFI	Goodness-of-fit Index
GOF	Goodness-of-fit
H1	Hypothesis 1
H2	Hypothesis 2
H3	Hypothesis 3
H4	Hypothesis 4
H5	Hypothesis 5
H6	Hypothesis 6
H7	Hypothesis 7
H8	Hypothesis 8
H9	Hypothesis 9
H10	Hypothesis 10
H11	Hypothesis 11
H12	Hypothesis 12
H13	Hypothesis 13
H14	Hypothesis 14
H15	Hypothesis 15
H16	Hypothesis 16
HE	Higher Education
HEI	Higher Education Institution
IDT	Innovation Diffusion Theory
IS	Information Systems
IT	Information Technology
ITU and IU	Intention to Use
KMO	Kaiser-Meyer-Okin
KSU	King Saud University
LISREL	Linear Structural Relations

M	Mean
MADAR	MADAR is an ERP software system that was locally developed at KSU in Saudi Arabia in order to meet budget constraints
MIS	Management Information Systems
MLE	Maximum Likelihood Estimation
MRP	Material Requirements Planning
MRPII	Manufacturing Resource Planning
MSA	Measure of Sampling Adequacy
NFI	Normed Fit Index
OLAP	Online Analytic Processing
OLS	Ordinary Least Square
PBC	Perceived Behavioural Control
PEOU or PEU	Perceived Ease of Use
PU	Perceived Usefulness
R <sup>2</sup>	Coefficients of Determination
RMIT	Royal Melbourne Institute of Technology
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SEM	Structural Equation Modelling
SN	Subjective Norm
SPSS	Statistical Package for the Social Science
TAM	Technology Acceptance Model
TAM2	Modified Technology Acceptance Model
TMS	Top Management Support
TOE	Technology–Organisation–Environment
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UNSW	University of New South Wales
Usage	Actual System Use
USAGE	Actual Use
USE	Actual System Use
UT	User Training
UTAUT	Unified Theory of Acceptance and Use of Technology
WWW	World Wide Web
$\chi^2$	Chi-square
YST	Yield Shift Theory of Satisfaction

## **CHAPTER ONE: INTRODUCTION**

### **1.1 INTRODUCTION TO THE SUBJECT**

In the current information age, businesses are challenged with creating different types of systems that are capable of working together in order to seamlessly share and exchange information. One way to overcome this problem is to employ enterprise applications (Bradford, 2011). Enterprise Resource Planning (ERP) systems are used in various business enterprises, including: educational, service, manufacturing, non-manufacturing, government and not-for-profit organisations (Bradford, 2011). The aim of ERP systems is to facilitate the procedures for all business roles within the precincts of the company and to manage links to external firms (Wang and Wang, 2014).

There are different definitions of ERP in the literature. Sometimes ERP is defined as a package, as a software application or as a system or computer-based application (Xia et al., 2010; Jing and Qiu, 2007). For example, Beheshti et al. (2014) and Panayiotou et al. (2015) define ERP as a software application that helps organisations to manage their business activities. However, with respect to HEIs, Rico (2004:2) defined an ERP system for HEIs as “an information technology solution that integrates and automates recruitment, admissions, financial aid, student records, and most academic and administrative services”. The ERP system refers to an application mechanism utilised globally for integrating information as well as business practices into a single database to assist higher learning institutions to minimise workflow duration and to boost efficiency (Swartz and Orgill, 2001). This is especially important because ERP systems have been shown to play an imperative role in rationalising and streamlining information systems throughout the entire organisation, thus leading to both operational improvements and increased business profits (Bradford, 2011).

Many multi-national companies around the world have already adopted an ERP system, while other small-sized companies have started to follow (Van Everdingen et al., 2000).



Different companies and HEIs have discarded legacy systems and introduced ERP systems for the integration of all business procedures into a single system (Seo, 2013). Since then, ERPs have evolved further and currently offer tools that promote telecommunication and education (Al Dhafari and Li, 2014).

Operations in HEIs have continuously changed over the past decade. This is due to technological advancements that have continued to empower and change the various methods of the HEIs' functionality. Adopting information systems within the higher education sector is critical towards its effectiveness and success of services, since information systems are important factors that influence quality outcomes, services and tasks (Abugabah and Sanzogni, 2010). Universities are likely to draw numerous benefits when they shift from ancient systems towards ERPs, including: reduction in paper usage, better information flow, enhanced efficiency, greater accessibility for administrative services, improved services for learners and faculty and improved access to data (Ahmad et al., 2011).

## **1.2 RESEARCH BACKGROUND**

Despite the considerable benefits that stem from implementing ERP systems, the implementation process is, however, complex, costly and time consuming (Scott and Vessey, 2002; Ramayah et al., 2007; Helo et al., 2008; Maditinos et al., 2011). Some research studies indicate that the ERP adoption failure rate is greater among HEIs than among businesses (Blitzblau and Hanson, 2001; Al Kilani et al., 2013; Abugabah and Sanzogni, 2010; Botta-Genoulaz and Millet, 2006). ERP implementation and integration is considerably more complex for HEIs (Ram et al., 2013). They are more opposed to change compared to private firms because of the loosely integrated and autonomously functioning administrative and academic units (Gates, 2004), alongside a decentralised authority structure (Rabaa'i et al., 2009). This uniqueness makes it more complex for technological developments to penetrate into the normal schedule of service provision in higher education.

Indeed, current ERP research has ignored the higher educational sector, even though several HEIs are implementing or have implemented an ERP system (Nielsen, 2002). Therefore, research on issues pertaining to ERP and higher education users represent a major feat in the analysis of the real benefits that are potentially brought by such systems. Although ERP systems within HEIs presently represent a huge software investment, it is unlikely to be final and universities are seeking to install and renew other business-wide systems in the future (Nielsen, 2002). Therefore, it is necessary to conduct further research on this area. In order to further the understanding of the impact caused by ERP adoption, the current study attempts to examine the factors that affect the adoption of ERP systems by HEIs. This stems from the suggestion that information systems cannot affect productivity, with the key efficiency factor characterising the manner in which individuals utilise the technologies (Basoglu et al., 2007).

### **1.2.1 ERP Adoption in Higher Education in Saudi Arabia**

Education in Saudi Arabia has experienced tremendous growth over the past decade. The Gulf region's information technology (IT) market is dominated by Saudi Arabia; accounting for approximately 3.4 billion US dollars in 2008 and the value was expected to reach 5.6 billion US dollars in 2013 (Market Research Reports, 2009). Numerous local benefits that are inherent in Saudi Arabia have been utilised for attaining this top position in the world of e-business, such as: the population structure, the communication network, the free economic approaches and the geographical location (ALdayel et al., 2011). In 2010, sixty-nine per cent of Saudi firms were running their operations with ERP systems and these systems have been adopted by 12 out of 24 government-sponsored HEIs in Saudi Arabia (ALdayel et al., 2011). However, according to Aljohani et al. (2015), poor assessment of the ERP systems to be adopted is a huge challenge within the current setting because this causes confusion as to what is required by the university and the way in which the new system will fulfil these requirements (Rabaa'i et al., 2009).

An extensive search of the literature has been conducted by the researcher to locate the studies that are related to ERP systems in HEIs, particularly those located in Saudi Arabia. The search was carried out using different journals, books, articles and Google Scholar.

There were several topics that were of interest to the different researchers of ERP systems in HEIs: change management strategies and processes, critical success factors (CSFs), stakeholder performance, technical aspects and social aspects.

Several researchers and scholars in Saudi Arabia have investigated the area of ERP systems at the King Saud University (KSU) and their focuses in this field have been to underline the change management and processes of an ERP system. For example, Al-nafjan and Al-Mudimigh (2011) provide a review of the literature focusing on the management factors that change an ERP. Alghathbar (2008) explores the implementation of an ERP system at KSU. Al-Shamlan and Al-Mudimigh (2011) investigated the most useful and efficient strategies for change management and the significant tools and processes for change management for the successful implementation of an ERP system at the same university.

Another area of interest was dedicated to the CSFs of ERP. Ullah et al. (2013) presented a case study for ERP implementation at KSU. The main aim of their research was to analyse the CSFs that may affect the success of ERP implementation in HEIs. ALdayel et al. (2011) explored and analysed the implementation of MADAR at KSU in a bid to identify the CSFs for a successful implementation. The case study measured the success of ERP implementation from both technical and user perspectives; examining 15 CSFs from the technical perspective and three CSFs from the user's perspective. In their case study, Aljohani et al. (2015) attempted to examine some important factors (e.g., public negativity, poor integration, dependency on foreign experts and trend pressure) that may affect ERP replacement in one of the universities in Saudi Arabia. Al-Hudhaif (2012) conducted his study on KSU in order to examine the factors that may influence the implementation of an ERP system from the users' perspective. The main objective of the study was to investigate the situation of MADAR implementation. Another case study, by Zubair and Zamani (2014), investigated the factors that may influence ERP implementation at another university in Saudi Arabia.

Other researchers were interested in the technical aspects of ERP systems. Al-Mudimigh et al. (2009) examined the application of data mining on ERP system (MADAR) data. The focus of the case study was on the organisation development and the improvement of customers' satisfaction at KSU. Another case study was investigated by Ullah and Al-Mudimigh (2012) to investigate the integration and collaboration of different departmental activities within KSU. The main objective of their research was dedicated to eliminating inconsistent data in the ERP system (MADAR).

Other researchers were interested in stakeholders' performance and social aspects. For instance, Althonayan (2013) proposed a theoretical framework to evaluate the stakeholders' performance of ERP systems in HEIs in Saudi Arabia. Agourram (2009) investigated the perceptions of information systems' (IS) success by managers who worked for a public university in Saudi Arabia.

### **1.2.2 Technology Acceptance Model (TAM)**

The Technology Acceptance Model (TAM) has received significant support from various empirical research studies (Venkatesh and Davis, 2000; Venkatesh, 2000; Taylor and Todd, 1995; Mathieson, 1991) when compared with other models such as: the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Innovation Diffusion Theory (IDT). Davis (1986) is deemed as the proponent of TAM, which is a derivative of TRA that was purposely fashioned to generate user acceptance of IT. TRA asserts that beliefs sway attitudes, which then bring about intentions and finally generates behaviour. TAM adopted this belief–attitude–intention–behaviour relationship in order to model user acceptance of IT.

TAM's objective, according to Davis (1989), is to provide a foundation to evaluate how internal beliefs and attitudes – as well as the intention of using technological gadgets, such as computers – is affected by external factors. The TAM model hypothesises that two specific beliefs – perceived usefulness (PU) and perceived ease of use (PEOU) – are of the utmost significance in the determination of computer acceptance behaviours. In other words, Davis (1989) assumes that potential users of IT are more likely to adopt the

technology if it is perceived as useful and easy to use. Davis defined PU as “the degree to which a person believes that using a particular system would enhance his or her job performance” and PEOU as “the degree to which a person believes that using a particular system would be free of effort” (1989:320). In TAM, individuals’ attitudes are important in the determination of their behavioural intention. On the other hand, an individuals’ behavioural intention of adopting a system is determined by their belief that the system will be important in improving their performance in the workplace. Moreover, the individual’s attitude is mutually contingent on both PU and PEOU.

A number of research studies with positive results have been conducted on ERP systems with the use of TAM. Lee et al. (2010) examined the factor of organisational support (formal and informal) on the original TAM factors. Calisir et al. (2009) examined the influence of different factors (subjective norms, compatibility, gender, experience and educational level) on behavioural intention to use an ERP system in one of the manufacturing firms. Hsieh and Wang (2007) researched the impact of PU and PEOU on extended use in one of the manufacturing organisations. In a similar vein, Shih and Huang (2009) attempted to explain behavioural intention and actual use through incorporated additional behavioural constructs: top management support, computer self-efficacy and computer anxiety. Amoako-Gyampah (2007) embarked on a study aimed at finding out how the behavioural intention of using ERP systems was influenced by PU and PEOU. In Blackwell and Charles’ (2006) study, willingness to change as well as behavioural intention to adopt ERP systems was investigated in students. Calisir and Calisir (2004) investigated the factors that have an impact on the satisfaction of end-users when operating ERP systems.

The application of one of TAM’s extensions in an ERP environment was examined by Amoako-Gyampah and Salam (2004). The results of this investigation implied that project communication and training have an effect on shared beliefs, while shared beliefs have an effect on the PU and PEOU of the IT systems. Others – like Sternad et al. (2013) – examined the influence of different external factors (e.g., organisational, technological, individual and information literacy) on the post-implementation stage of ERP usage.

Bradley and Lee (2007) examined the relationship between training satisfaction and PU, PEOU and perceived effectiveness and efficiency on the adoption of ERP systems in one university. Their findings indicated that training satisfaction has an influence on ERPs' ease of use and that both training and user participation influenced the perceived effectiveness and efficiency of the ERP systems.

Several research studies have been dedicated to examining the adoption of ERP in the context of Saudi Arabia. For example, Al-Jabri and Al-Hadab (2008) examined the effect of expected value, expected capability, ease of use and usefulness on individuals' attitudes towards ERP. A more recent research study by Al-Jabri and Roztocki (2015) employed TAM and TRA models in a bid to extend prior research on ERP adoption by adding perceived information transparency as an external factor to the model.

### **1.2.3 Theoretical Framework to be Adopted in this Research**

Many empirical research studies (such as Adams et al., 1992; Segars and Grover, 1993; Davis and Venkatesh, 1996; Szajna, 1996) confirm the validity of TAM under various tasks, situations and technologies. Nonetheless, Davis et al. (1989) suggested that TAM should include other external factors (e.g., individual and organisational factors) when evaluating the acceptance of a specific technology because they may directly affect that technology's PU and PEOU. This may, in turn, indirectly influence technology acceptance behaviour (Szajna, 1996). External factors act as the link between an individual's innate beliefs, attitudes and intentions and the numerous individual variations, circumstantial limitations and managerial controllable interventions that affect behaviour. According to Moon and Kim (2001), external factors are prone to variations depending on the technology, target users and context. Nonetheless, there is no general unanimity regarding the precise factors that may affect IT adoption. This has been supported by Chung et al. (2009), who suggested that while different studies seem to overlap with each other in terms of the factors that affect the adoption of ERP systems, there is no general consensus regarding the factors that are absolutely imperative to the success of all ERP projects.

Technology adoption is not entirely dependent on the technical aspects of IT. External aspects – such as organisational and individual characteristics – are also important in order to facilitate adoption (Orlikowski, 1993). The implementation of ERP systems is complex and, therefore, their adoption is prone to major problems that are related to organisational and individual issues, rather than to technical issues (Pan and Jang, 2008; Helo et al., 2008). Thus, ERP systems require individual perspectives coupled with organisational viewpoints. According to Gefen (2004), when organisations make their ERP systems both useful and easy to use by their employees, this helps both organisational and individual strategic issues. Therefore, a good understanding of users' beliefs (e.g., PEOU and PU) is necessary.

Different research studies (such as: Amoako-Gyampah and Salam, 2004; Bradley and Lee, 2007; Bueno and Salmeron, 2008; Calisir et al., 2009; Shih and Huang, 2009; Sternad et al., 2011) have used TAM and applied it to ERP systems by incorporating new factors in order to gain a better understanding of the determinants of technology acceptance and to increase TAM's predictive validity. Research studies that utilise TAM to understand ERP adoption have considered individual and organisational factors as independent factors that may affect the usage of ERP systems. Individual factors, as well as computer usage, are the main determinants of ease of use (Venkatesh, 2000). Organisational characteristics capture various social processes, mechanisms and support organisations that guide individuals and facilitate the use of an ERP system. Various studies (such as Igbaria and Chakrabarti, 1990; Amoako-Gyampah and Salam, 2004; Bradley and Lee, 2007) have confirmed the significance of organisational variables on the attitudes of users, especially during the adoption of new ERP technologies. Therefore, in addition to the core determinants of TAM, this research will include other sets of factors (organisational and individual) that may affect the adoption of ERP systems in HEIs.

A better understanding of the factors contributing to ERP users' acceptance of ERP systems is necessary to facilitate successful ERP usage (Nah et al., 2004). In the current research, the aims are to identify those factors leading users to improved use of their ERP system, to expand the basic TAM model with more generic contextual factors and to then

examine their influence on the PU and PEOU of ERPs. Studying the influence of external factors on constructs not only contributes to the theory development, but also helps in designing interventional programmes for organisations.

Based on the above discussion regarding ERP systems, two main categories of factors have been adopted in this research. The first category is organisational factors, such as top management support and user training. The second category is individual factors, such as subjective norm, computer self-efficacy and computer anxiety. These external factors (both organisational and individual) have been validated in different empirical studies, including research relating to ERP adoption, and have strong support in the literature. This research will also include external factors that are not presented in TAM; this may help in providing a better understanding with regards to the use of ERP systems in HEIs.

#### **1.2.4 Research Motivation**

The lack of comprehensive research on the adoption of ERP systems in the higher education sector motivated this research study. None of the previous studies have provided clear instructions for the effective adoption of ERP systems in HEIs. In addition, the existing research studies have never attempted to develop a conceptual framework for ERP adoption in HEIs (which is the focus of this research study), despite the fact that HEIs are still adopting ERP systems.

According to the different research studies that have been conducted in HEIs in Saudi Arabia (e.g., Al-Shamlan and Al-Mudimigh, 2011; Zubair and Zamani, 2014), the main reason for ERP failure in HEIs in Saudi Arabia was either the resistance of users to change or the unwillingness of users to accept the new technology. Another study (Agourram, 2009) indicated that the users' perceptions at both the organisational and the individual level are not understood. Thus, research studies should place emphasis on examining the ways that ERP systems are adopted and utilised by individuals, and more attention should be given to this aspect because it may influence the use of the ERP system that forms the attitude as well as the behaviour of the system's users. Therefore, this research study aims to resolve this research problem.



### 1.3 RESEARCH AIMS, OBJECTIVES AND QUESTION

Davis et al. (1989) suggested that TAM should include other external factors (e.g., individual and organisational factors) when evaluating the acceptance of a specific technology because they may directly affect that technology's PU and PEOU. This may, in turn, indirectly influence technology acceptance behaviour (Szajna, 1996).

The overall aim of this research is to develop a model of factors affecting the adoption of ERP systems in HEIs. ERP adoption will be studied from the information systems' acceptance point of view, referring to the idea that HEIs must utilise the information system in order to achieve a competitive advantage and that, therefore, extra knowledge of the factors that affect IT adoption is required to better comprehend and facilitate acceptance.

This research has four objectives:

1. To investigate the number of HEIs that use ERP systems in Saudi Arabia.
2. To examine various technology adoption frameworks for the adoption of ERP systems in HEIs.
3. To identify the factors affecting the adoption of ERP systems in Saudi Arabia's HEIs and to develop a theoretical model for ERP adoption in that setting.
4. To conduct an empirical study and examine the relationships and relevancy amongst the factors influencing the adoption of ERP systems by HEIs, based on the TAM model.

The primary research question is:

*What are the factors affecting the adoption of ERP systems by HEIs in Saudi Arabia?*

A further question is:

*What are the relationships between the factors influencing the adoption of ERP systems in HEIs in Saudi Arabia, based on the TAM model?*

#### **1.4 RESEARCH METHODOLOGY**

This study is accomplished within a largely positivist model. Therefore, it commences with a broad review of related literature with the intent of identifying a theoretical framework of the pertinent factors affecting the adoption of ERP systems in HEIs. According to the positivists, while reality is objective it can be characterised by quantifiable properties. The aim of the positivist is to examine theory in order to maximise the phenomena's understanding (Myers, 2010). Abbas (2011:124) stated that "Information systems research can be classified as positivist if there is evidence of formal proposition, variables (dependent and independent) that can be quantifiable, hypothesis testing, and the drawing of inferences about a phenomenon from the selected sample". Since the researcher is interested in identifying the main factors (variables that can be quantifiable) affecting the adoption of ERP systems in the HEI environment, this research study is thus positivist in nature.

In this study, the researcher identifies the primary stage as the identification of factors affecting, or that may affect, the adoption of ERP systems in the HEIs of Saudi Arabia. The reviewed literature facilitates sufficient background regarding the level of study in the context of users' acceptability within the general IT field and, particularly, the ERP field. Additionally, the literature review facilitates the choice of the baseline replica that is engaged to verify the significant main factors affecting the adoption of ERP systems in HEIs. Based on the literature review, and TAM, the proposed model of this research will be constructed.

Quantitative methods are "means for testing objective theories by examining the relationship among variables, which, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures" (Creswell, 2009:17). In addition, Creswell also stated that in such methods authors make "assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings" (2009:4).

This method facilitates the dividing of phenomena into more clear, controllable and well-defined variables. Quantification plays a critical role in breaking phenomena into specific and practical elements for a well-established conceptual framework (Abbas, 2011). Since the intricate nature of the ERP system incorporates an objective measure of business outcome, a quantitative method is required to test objective theories by examining the relationships between variables. Such variables can be measured on instruments where data is numbered and analysed by the use of statistical processes (Creswell, 2009).

Survey is one of the most familiar study strategies because it facilitates the gathering of a large quantity of information from a huge population comparatively economically (Sim and Wright, 2000; Remenyi et al., 1998). Owing to the fact that this research aims at developing a model of factors affecting the adoption of ERP systems in HEIs, there is an urgency to have the model tested on a large sample. This requires supplementary questions that follow previous work in the field. The use of a survey method to collect data allows the researcher to suggest possible reasons for particular relationships between variables and to produce a model of these relationships. Thus, the survey strategy is preferred because it satisfies the nature of this study and its aims and objectives.

In order to examine the factors that may affect the adoption of ERP systems by HEIs, this research study utilises instruments that have been validated and applied by previous research studies (e.g., Davis, 1989; Nah et al., 2004; Venkatesh, 2000). The instruments have been altered to suit the ERP context. The reason for utilising validated instruments from prior research studies is to add face validity to this research study.

A survey will be used to test the hypotheses regarding the structure of the proposed model. This research applies multivariate analysis (e.g., factors analysis (FA) and structural equation modelling (SEM)) as analytical techniques to revise and examine the proposed model of HEIs' adoption of ERP systems. Confirmatory factor analysis (CFA) will be applied to confirm or reject the proposed model, as well as to examine the validity of the hypothesised measurement model via convergent validity and discriminant validity tests during the CFA stage. The next stage encompasses the application of structural equation

modelling (SEM) to examine the relationships between unobserved and observed variables. Finally, an Analysis of Variance (ANOVA) technique will be carried out to determine any demographic differences that arise over the factors of the study.

The main statistical techniques used in the analysis are:

1. **Confirmatory factor analysis (CFA)** will be performed on the hypothesised measurement model.
2. **Structural equation modelling (SEM)** will be performed on the structural model to evaluate the hypothesised relationships that predict institutions' actual use of ERP systems.
3. **Analysis of Variance (ANOVA)** will be used to determine some demographic differences on the factors of the study, such as: gender, experience, department, level of education, age and marital status.

## **1.5 RESEARCH CONTRIBUTIONS**

The current study provides both theoretical and practical contributions. The development of a new model extends the body of knowledge of the existing literature and research related to technology acceptance and, more specifically, to the adoption of ERP by HEIs. The major contribution of the current study would be that the suggested model extends the technology acceptance model by the inclusion of external factors. The research model in this study extends the prior research by incorporating organisational and individual factors from previous literature and theories. Despite the wide recognition of these factors in previous models, the majority of previous studies, if not all, have failed to apply them in a single model in order to understand their influences on ERP adoption in the higher education field.

The current study also expands the TAM domain to the ERPs of HEIs. TAM is well designed for adoption to different kinds of IT application; however, it is yet to be used on the application of ERP systems within the context of higher education, especially in

developing nations. The study ought to produce considerable understanding from the two sides of the current model – namely new context as well as adoption – within the new domain. Moreover, the current research can offer measurable benefits to IT practitioners and HEIs with regard to the issues of successful IT design alongside implementation in education. When intending to create and use a new IT, higher learning institutions will be in a better position of predicting whether the IT would be welcomed amongst their staff (i.e., learners, academics, managers and workers).

Along with these academic contributions, practical contributions are anticipated from this study because HEIs need to enhance performance in the current competitive setting. This conceptual basis is aimed at providing an insight on the possible management procedures and activities that managers might utilise for examining the complexity of the ERP, thus equipping them with an instrument for exploiting its potential. This is critical because HEIs face challenges when applying ERPs through mechanisms that enable them produce the anticipated benefits.

In addition, this study provides useful insights into the relationship between the factors and actual use of ERP systems. This will enable HEI adoption teams and technology developers to better understand the key determinants of user acceptance of a new system and to realise how different decisions may influence the success of the new systems they produce. Therefore, the proposed model serves as a framework for thinking through and establishing different requirements and development criteria for the new system.

## **1.6 ORGANISATION OF THE THESIS**

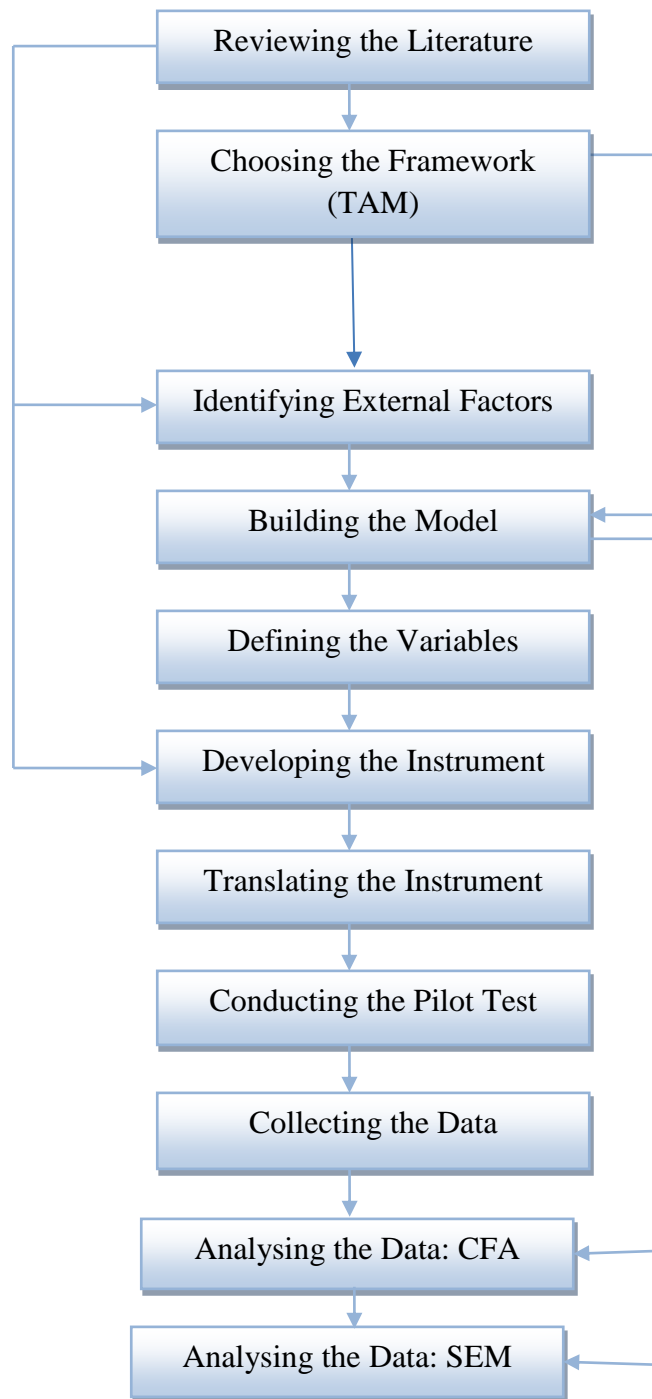
This thesis consists of seven main chapters. Chapter One is an introduction to the study. Chapter Two is a comprehensive review of the literature in order to become well acquainted with the true essence of the effects, benefits and challenges of the adoption of ERP systems in the context of HEIs. The review includes a general overview of IT systems and an explanation of the adoption of ERP systems as it is applied in the HEI context. Chapter Three discusses the main theories that pertain to the acceptance of technology, and empirical studies that have generally drawn on TAM, specifically in the context of

ERPs, are presented. In addition, this chapter includes a discussion about the main factors that have an effect on the adoption of ERP systems, and the last part of this chapter describes the proposed models, research questions and hypotheses of this study.

Chapter Four describes the methodology used in this research. It is organised around four major topics: research philosophy; research strategy and methods; research models and instrument development; and the sampling design and procedures followed to gather data. Chapter Five introduces the major techniques used in quantitative data analysis by the use of multivariate analysis techniques. The main topics described in this chapter are CFA and SEM. In Chapter Six, the CFA and SEM techniques have been employed to study the underlying variables. The chapter provides validation of the proposed model and clarifies the nature of the relationships between the main variables. Finally, Chapter Seven summarises the main results of this research, discusses the implications and then provides some recommendations for future research.

## **1.7 SUMMARY**

The overall aim of this research is to develop a model of factors affecting the adoption of ERP systems in HEIs. ERP adoption will be studied from the point of view of the acceptance of information systems, referring to the idea that HEIs must utilise the information system in order to achieve a competitive advantage. Therefore, extra knowledge of the factors that affect IT adoption is required in order to better understand and facilitate acceptance. Figure 1.1 offers a flow chart indicating the phases of developing the research model in this study.



**Figure 1.1: Phases of Developing the Research Model.**

## **CHAPTER TWO: LITERATURE REVIEW ON ERP AND ITS ADOPTION**

### **2.1 INTRODUCTION**

Webster and Watson (2002) argue that the effectiveness of the published literature on a given subject should be judged by its ability to create a strong foundation for future research. An effective literature should facilitate the development of theories, the identification of areas that do not require any further research and the identification of areas that have potential for research (Webster and Watson, 2002). Therefore, in order to become well acquainted with ERP adoption in a HEI context, a comprehensive review of the relevant literature has been carried out in this chapter.

The chapter includes a general overview of information systems and a discussion of ERP systems' definitions and evolution and the reasons behind their adoption. In addition, this chapter discusses the benefits and challenges of ERP systems and their implementation in the HEI context. Studies on ERP in HEIs in Saudi Arabia are also discussed. Finally, a summary is provided at the end of this chapter.

### **2.2 INTRODUCTION TO INFORMATION SYSTEMS**

In order to support the basic concepts of what shapes an ERP system, it is important to explain the definition of information systems that has been adopted in this research. According to Iivari (1991), an information system is a combination of subsystems defined either by organisational or functional parameters in order to help users make decisions, as well as to control their organisations. For firms to remain competitive they need to adopt and employ information systems that, in turn, help them to enhance information flow, reduce costs, offer product and service variety, improve relationships with suppliers and enhance customer service levels (Alavi and Leidner, 2001; Kyoong et al., 2011).

Lucas (1981) indicates that IT is helpful in capturing, storing, transmitting, retrieving and manipulating information in different businesses. It can be considered an enabling tool to not only enhance firms' performances by providing communications across different



functions to improve the effectiveness and efficiency of performance management, but also to help decision makers to optimise and evaluate the effect of business process changes. Information systems provide firms with useful information and processes for their customers and members.

In the current information age, businesses have the challenge of creating systems that are capable of working together in order to seamlessly share and exchange information. One way to overcome this problem is to employ enterprise applications. Such systems can execute, integrate and coordinate an organisation's entire business processes at different managerial, operational and tactical levels, improving its productivity (Laudon and Laudon, 2016).

The four major types of enterprise applications are: supply chain management systems, customer relationship management systems, knowledge management systems and enterprise systems. Enterprise systems are also known as ERP systems, which are the focus of this research. According to Bradford (2011), ERP systems are used in various business enterprises including educational, service, manufacturing, non-manufacturing, government and not-for-profit organisations. The aim of ERP systems is to facilitate the procedures for all business roles within the precincts of the company and to manage links to external firms (Wang and Wang, 2014).

## **2.3 DEFINITION OF ERP SYSTEMS**

Regarding the definition of what is an ERP, it is critical to address that there is no unanimity regarding the used terminology and that there are various definitions in the literature. Based on the English expression, the term "Enterprise Resource Planning" means a methodology or an instrument that can be used to manage an organisation's internal and external resources. There are also different specific definitions of ERP in the literature. It has been defined as a package, as a software application or as a system or computer-based application (Jing and Qiu, 2007; Xia et al., 2010). For example, Ancveire (2018) and Saini et al. (2013) defined ERP systems as software packages designed to allow companies to control and manage their resources efficiently and effectively; whereas, Beheshti et al.

(2014) and Panayiotou et al. (2015) define ERP as a software application that helps organisations to manage their business activities.

According to Jalal (2011), ERP systems refer to software that is used for business management and comprises various combined applications that firms may utilise to gather, store, manage and interpret data from various business ventures. Such networks have been applied extensively within companies. In addition, several researchers have described ERP systems as “off-the-shelf” software packages that assist most of the operational functions of an enterprise (Davenport, 2000; Markus et al., 2000; Saadé et al., 2017). Alternatively, Shanks et al. (2000) have defined ERP as the entire software solution used to integrate the processes of an organisation through data flow and shared information. Similarly, Watson and Schneider (1999) focused on the fact that the ERP system is used for customising and integrating software solutions in order to fulfil the main information system requirements for an organisation (Madanhire and Mbohwa, 2016).

With regard to HEIs, Rico (2004:2) defined an ERP system for HEIs as “an information technology solution that integrates and automates recruitment, admissions, financial aid, student records, and most academic and administrative services”. Robert (2007) described ERP systems in HEIs as multiple in scope, tracking a range of activities that include human resources systems, student information systems and financial systems.

ERP systems can typically be employed to optimise many business activities, for instance: production, marketing, logistics, management of inventory, human resources and quality management. They help bring to the fore an aspect of accountability within all of the activities of an organisation (Bradford, 2011). The fundamental purpose of an ERP software system is to equip a business with a tool that will enable it to generate a flawless, integrated information course throughout the entire organisational processes, both internally and externally (Gürbüz et al., 2012).

It is obvious that terminology in defining ERP systems differs from researcher to researcher. For the purpose of this study, therefore, we define ERP systems as customised software packages that have the ability to integrate organisations' functions and business processes and that provide just-in-time information in order to improve controls and enhance ease of use and usefulness amongst ERP users. Table 2.1, below, illustrates the different definitions of ERP systems.

**Table 2.1: ERP System Definitions.**

	<b>ERP Definitions</b>	<b>Source</b>
1	ERP is defined as a package, as a software application or as a system or computer-based application.	Jing and Qiu (2007); Xia et al. (2010)
2	ERP is defined as a software application that helps organisations to manage their business activities.	Beheshti et al. (2014); Panayiotou et al. (2015)
3	ERP systems are defined as software packages designed to allow companies to control and manage their resources efficiently and effectively.	Ancveire (2018); Saini et al. (2013)
4	ERP systems refer to software that is used for business management and comprises various combined applications that firms may utilise to gather, store, manage and interpret data from various business ventures. Such networks have been applied extensively within companies.	Jalal (2011)
5	ERP systems are “off-the-shelf” software packages that assist most of the operational functions of an enterprise.	Bancroft et al. (1998); Davenport (2000); Markus et al. (2000)
6	ERP is the entire software solution used to integrate the processes of an organisation through data flow and shared information.	Shanks et al. (2000)
7	An ERP system for HEIs is “an information technology solution that integrates and automates recruitment, admissions, financial aid, student records, and most academic and administrative services”.	Rico (2004:2)

## **2.4 EVOLUTION OF ERP**

The ERP system is an extremely specialised system that was developed from material requirements planning (MRP) and manufacturing resource planning (MRPII; Anderegg, 2000). The MRP model was developed and initiated in the 1960s and was used to support and harmonise various operational tasks like inventory, accounting and production. However, MRP has rigid functions that are coupled with limited integration capabilities, such as integration between users and data (Hwa and Snyder, 2000). In the 1980s, MRP was expanded and developed into MRPII (Gray and Landvater, 1989) and became the manufacturing technology that planned and controlled resources such as production, finance and marketing (Robert, 2007). Nevertheless, the capabilities of MRPII failed to provide the required integration tailored to contemporary manufacturing needs (Yusuf and Little, 1998).

Due to the immense demand for particular and more sophisticated MRPII features in the market, as well as the inability of MRPII to harmonise all of the organisational tasks, ERP systems were introduced during the 1980s and 1990s (Helo et al., 2008). The successful development of these ERP systems was attributed to the declining cost of hardware used in computer systems and the fast development of computing technology. Yusuf and Little (1998) explain the key differences between the ERP and MRPII systems in terms of functionalities, where they assert that the functionalities of the ERP systems – for example, management of the supply chain, maintenance support, planning of human resources and financial accounting, as well as sales and distribution – have surpassed the ability of those of the MRPII systems.

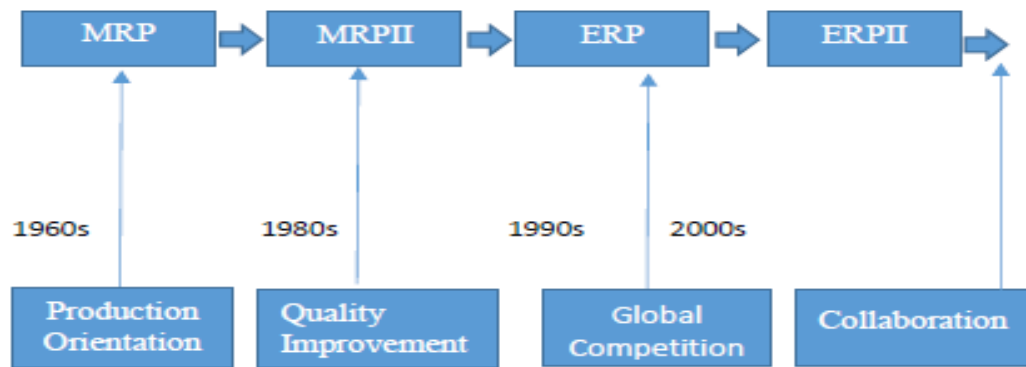
In the 1990s, the sales of ERP systems burgeoned and this was attributed to the Y2K problem that affected the legacy systems of many organisations. Since these legacy systems proved to be costly, difficult to operate and time consuming, organisations were forced to abandon them (Holland et al, 1999). The most suitable replacement for the legacy systems were the ERP systems because, unlike the legacy systems, they were flexible and capable

of aligning organisations with their strategies. According to Monk and Wagner (2006), organisations that continued using the legacy systems experienced a dramatic decline in sales in the last quarter of 1999.

The functionalities of ERP systems were augmented to deal with accounting, inventory, shopping, invoicing, logistics, distribution and education. In addition, ERP systems were also designed to handle various business operations, such as human resource management, production, delivery, billing, sales, marketing and quality management (Chang et al, 2000). Chang et al. (2000) explained that ERP systems have been significantly adopted in a myriad of profit organisations, non-profit organisations, manufacturing companies, non-manufacturing companies and government institutions.

The functionalities of ERP systems have been augmented over the years to take account of the next generation of enterprise applications. Demand for integrated information systems, increased competitiveness and further advancements in technology (such as electronic business) have required that ERP vendors develop a new phase of the ERP life-cycle, called the ERP II system. Møller (2005:483) stated that ERP II systems are a “transformation of ERP into the next-generation enterprise”. ERP II is web-based system that provides electronic collaboration in the supply chain. It complements the traditional ERP system because it has additional functions, such as supply chain management, customer relationship management and internet connectivity.

The traditional ERP systems provide efficiency to intra-organisational processes, while ERP II systems provide inter-organisational collaboration. ERP II enhances the organisational flexibility that may lead to competitive advantage. Flexibility is a key attribute for organisations in order to gain a competitive advantage (Karmarkar, 1989). The internet connectivity aspect of ERP II allows both the organisation’s staff members and its external users to access to the system’s records and statistics in real time. Figure 2.1 illustrates the evolution of ERP systems.



**Figure 2.1: Evolution of ERP.**

Despite the potential benefits of ERPs, their implementation is complex and as such often fails. However, organisations are still adopting ERP systems for different reasons and the following section (Section 2.5) discusses some of these reasons.

## **2.5 REASONS FOR ADOPTING ERP**

The popularity of ERP systems has increased over time. The reason for such growth stems from the enormous transformation in businesses caused by high demand for faster services, lower prices and wider choice. The need for standardisation and globalisation and the highly unpredictable changes in customer expectations are other factors contributing to the growth of ERP systems.

Over the last two decades, ERPs have evolved further and currently offer tools that promote telecommunication and education (Al Dhafari and Li, 2014). Many companies and HEIs have discarded legacy systems and introduced an ERP system in order to integrate all business procedures into a single system (Seo, 2013). This integration between business units is one of the reasons that enable organisations to work as a single system. Grant et al. (2013:24) define integrations as “the collection of IT-related components, including systems and users, to create a unified and seamless whole”. The ERP system refers to an application mechanism utilised globally for integrating

information, as well as business practices, into a single database to assist HEIs and other organisations in minimising workflow duration and boosting efficiency (Swartz and Orgill, 2001). ERPs have been shown to play a very important role in rationalising and streamlining information processes throughout the entire organisation, thus leading to both operational improvements and increased business profits (Bradford, 2011).

In order for a software package to be regarded as an ERP system, it should have a number of particular attributes such as the ability to integrate information, to function in real time and to enable the access of all applications by one database repository so as to avoid data redundancy and duplications in data definitions. According to the Gartner Research Group (1992), ERP systems are software packages that wield highly integrated abilities and are sufficiently flexible to address the unique needs and requirements of an organisation. These software packages integrate the main functions (finance, accounting, business management and logistics) required to manage and control the procedures of the organisation by providing “cross-organization integration” of data through embedded business processes (El Masbahi et al., 2012). ERP systems were developed to simplify the flow of information and to integrate an organisation’s procedures so as to promote synergy. With ERP systems, the information systems department is liberated from the duty of integrating tasks and duties because users can access all requisite information from the system (Sheilds, 2001).

Furthermore, organisations operating in difficult and complex environments could be affected by different forces, such as governmental regulations (e.g., taxation and security), economic conditions (e.g., economic recession) and changes in customers’ demands (e.g., high quality, reasonable prices and service and product flexibilities). In such a complex environment, the main challenge for organisations is to optimise their supply chain by increasing their resource utilisation and enhancing customer service compatibility. This needs an integrated information system in order to share information on different “value-adding” activities within the supply chain (El Masbahi et al., 2012:182).

Competitiveness is another key reason for adopting ERP systems (Ugrin, 2009; Poba-Nzaou et al., 2012). Information systems are important for business survival and

competitiveness (Gunasekaran and Ngai, 2004). Organisations implement ERP systems in order to know how to use ERP systems to improve their competitiveness (Lai et al., 2010). However, organisations cannot achieve competitive advantage by only implementing an ERP system (Karimi et al., 2007). It is the way that the implementation and configuration are fulfilled that can leverage the probability of gaining competitive advantage. Zheng and Zhou (2011:1024) stated that “it is how end-user organizations use the ERP that is of importance, and it could be that having a unique ERP system is not that important”.

Mata et al. (1995) mentioned that organisations can gain competitive advantage from adopting IT if they know how to manage their resources (e.g., technical skills, capital requirements and technology). This means that ERP software suppliers and distributors gain competitive advantage when they utilise their resources to develop and implement ERP systems that meet the needs of their potential customers. Further, end-users need to utilise ERP systems in order to support their businesses (Zheng and Zhou, 2011).

Generally, ERP systems provide different benefits for different organisations. Research confirms that the benefits (e.g., improved performance, efficiency, productivity, decision making, business growth, resource planning and supplier–buyer relationship and reductions in costs) stem from ERP implementation and can ultimately lead to competitive advantage (Shang and Seddon, 2000; Woo, 2007; Goeke and Faley, 2009; O’Brien and Marakas, 2013; Aljohani et al., 2015). However, the reasons for adopting ERP systems differ from one company to another, and it depends on the company’s priority order, as well as its context.

Samundsson and Dahlstrand (2005) concisely indicated that the steadily growing competition between technology-based companies has made knowledge the most important tool that can be used to capitalise on the available opportunities in contemporary businesses, as well as in other non-business organisations (e.g., HEIs). Similarly, Goel et al. (2011) assert that with the high growth in the number of HEIs, as well as the advancement of computing technology in HEIs, ERP adoption could be one way of gaining competitive advantage. Murphy (2004:17) stated that “institutions, which are



unlikely to switch to integrated information solutions, will find it difficult to retain their market share of students. Students will, sooner or later, demand services offered by other institutions”.

## **2.6 THE IMPLEMENTATION OF ERP IN HEIs**

ERP systems have grown over time to become significant computer software systems in organisations. Many multi-national companies have already adopted an ERP system, while other small-sized companies have started to follow (Everdingen et al., 2000). Morris and Venkatesh (2010) suggest that close to 80% of Fortune 500 firms have adopted ERP.

Operations in HEIs have continuously changed over the past decade. This is due to technological advancements that have empowered and changed the various methods of the HEIs’ functionality. This has resulted in the majority of HEIs becoming focused on practical and realistic factors, such as growth, increased competition between different education providers and the varied needs and requirements of various stakeholders. These factors have led to many HEIs investing intensively in technology so as to provide their students and staff with the latest IT.

Moreover, student loans, comprehensive statistical returns, programme specifications, institutional audits, subject reviews and quality assurance procedures have all implied that the management workload, coupled with the administrative work, needed in HEIs is considerably higher compared with the past. Such alterations, within IS terms, have required the production and maintenance of huge quantities of information, along with the inclusion of several new processes for addressing these. Additionally, time has emerged as a significant pressure. Departments and faculties have become dependent on one another for information and users have been left with initial traditional file systems that were not integrated or developed for the upcoming tasks (Bentley et al., 2013).

In addition, the increasingly competitive global higher education environment and the decreased funding available to individual students have forced universities to come up with strategies and initiatives to pursue efficiency. Furthermore, shifting consumer needs

and higher expectations from stakeholders, such as governments, have prompted HEIs to seek competitive and efficient management practices, mostly with the help of the private sector (Stilwell, 2003).

The use of integrated IT solutions is no longer optional. Complex business processes in all kinds of businesses have prompted the need to go through an ERP exercise. ERP is important for the management of HEIs (Tortorella and Fries, 2015) and therefore integrated IS continues to strategically evolve as a tool for universities (Haneke, 2001). This is because clear organisation, as well as integration of processes, becomes the immediate focus. Today, universities and many HEIs are implementing ERP solutions. Abugabah and Sanzogni (2010:395) stated that “in the last few years higher education institutions spent more than 5 billion dollars in ERP investment”. Universities have adapted to the shifting needs and environment by initiating management as well as structural adjustments, outlined by Stilwel (2003) as the universities’ adoption of an “entrepreneurial character”. Changes in ERP systems represent one such adjustment, influencing how information is managed and users are served. ERP systems address problem-solving approaches, while also addressing staff development.

It is important for HEIs to incorporate the use of ERP systems in order to systematise, manage and assimilate all their day-to-day operations. Educational ERP solutions are designed to assist HEIs in mechanising all internal, external and communication processes (Murphy, 2004). The design of an educational ERP system incorporates the comprehensive functionalities of any HEI from the different perspectives of various individuals (such as management, lecturers and staff). This is done to ensure effective management of data, so as to easily retrieve the precise information required.

An educational ERP system has similar strengths to a traditional ERP system. This includes the reduction of data inaccuracy and ensuring the efficient management of information and resources (Abbas, 2011). Additionally, the system provides flexibility for students and staff. It allows the students to apply for financial funds, enrol and register for classes, access their own data and check their grades. The staff can access their personal

records and search new positions without actually visiting the human resources department.

The implementation of ERP solutions is more far complicated than simply installing software in the traditional way; it requires changes in the organisation's structure, management, strategy, skills and behaviours. According to Hooks (2002), the success of ERP implementation cannot be determined by the software itself because human involvement during the implementation must be taken into consideration too. Change management programmes must be considered and without that the successful implementation of an ERP system will be difficult (Hooks, 2002).

Further studies by Bingi et al. (1999) and Wassenaar et al. (2002) have evaluated the differences between the actual and the expected benefits of ERP systems. These studies stated that many top managers were discouraged by the limited real benefits and heavy investment required for ERP systems in their organisations. The decision for adopting an ERP system requires a long-term commitment, as well as considerable investments in both money and time. Therefore, implementing ERP systems in HEIs has proved to be a daunting task. In one study, Rabaa'i et al. (2009) revealed that ERP implementation did not meet the expected outcomes in 60–80 per cent of HEI contexts. Bradley and Lee (2007) found that, just like other institutions, universities encounter problems such as coordinating resources, control of costs and motivating staff members to embrace the ERP systems.

In 2006, Botta-Genoulaz and Millet found that ERP projects' expected outcomes were infrequently reached and their costs were often underestimated. For instance, Cleveland State University (1998) contemplated suing their ERP vendor when their new system was unable to handle more than half of their transaction volume. However, they did not relent and continued with the implementation despite the increasing costs. The entire project cost \$15M instead of the \$10.8M that had initially been projected. For Ohio State

University, the entire ERP implementation project cost \$85M instead of \$53M, and for the University of Minnesota the project cost \$60M instead of \$38M.

Allen and Kern (2001) found that the implementation of ERP systems in four UK universities was made problematic owing to their academic culture. The adoption of ERP systems in Australian HEIs has also encountered numerous complications that are unique to universities (Nielsen, 2002; Von Hellens and Beekhuyzen, 2005). In fact, the complications have sometimes been so adverse that Australian newspapers have considered the ERP projects in universities – such as Adelaide University, Royal Melbourne Institute of Technology (RMIT) and University of New South Wales (UNSW) – as failures (Mandal and Gunasekaran, 2002). Despite these failures, a significant growth has been seen in the implementation of ERP systems (as indicated by various surveys and case studies). This is evident because a large number of HEIs have implemented ERP systems in their institutions.

Indeed, current global ERP research has ignored the higher educational sector, even though several HEIs are implementing or have implemented an ERP system (Nielsen, 2002). Therefore, research on issues pertaining to ERP and higher education users represent a major feat in the analysis of real benefits that are potentially brought by such systems to firms. Although ERP systems within HEIs presently represent a huge software investment, it is unlikely to be final. Universities are seeking to install and renew other business-wide systems in the future (Nielsen, 2002). This makes it necessary to conduct further research on this area. For further understanding of the impact caused by ERP adoption, the current study attempts to examine the factors that affect the adoption of ERP systems in HEIs. This stems from the suggestion that information systems cannot affect productivity, with the key efficiency factor characterising the manner in which individuals utilise the technologies (Basoglu et al., 2007).

The following subsections (Sections 2.6.1 to 2.6.3) will discuss the benefits and challenges of ERP systems in HEIs, as well as the adoption of ERP systems in Saudi Arabia. The

final subsection (Section 2.6.4) will discuss several studies on ERP adoption within the context of Saudi Arabia.

### **2.6.1 The Benefits of ERP Systems in the Context of HEIs**

The main aim of implementing ERP systems in HEIs is to integrate various administrative systems (e.g., financial systems, student administration systems and human resource management systems) that were previously supported by the legacy systems (Rabaa'i et al., 2009). According Allen and Kern (2001:150), legacy systems are “disparate and lead to duplication of resources and services”. Thus, HEIs have adopted ERP systems as a solution to resolve this. HEIs are likely to draw numerous benefits when shifting from legacy systems to ERP, including a reduction in paper usage, better information flow, enhanced efficiency, greater accessibility for administrative services, improved services for learners and faculty and improved access to data (Ahmad et al., 2011).

Judith (2005) examined the effects of ERP systems on performance processes within universities. Specifically, his study sought to determine whether ERPs increase performance processes and this was achieved by examining the functions of various factors that include culture, leadership, business performance and ERP effects. The study observed that ERP significantly enhances business performance within universities via an improvement in the services given to staff, faculty and students.

ERP systems provide a range of advantages to HEIs in attending to their needs. The foremost goal is to integrate all institutional processes, such as accessibility to staff records by staff and student information. ERP systems have introduced a technique for integrating management systems in universities by supporting academic and administrative services, inclusive of those meant for financial management, human resources and staff (Ahmad et al., 2011). The ERP system assists in improving the entire institution's services, improving administration and management, upholding competitiveness and enhancing operation efficiency. This is made possible due to the ERP system's capacity to adapt to multi-vendor and multi-engine architecture and the system's ability to work with existing

systems and competently control and tap data in all places in legacy systems, spreadsheets or an up-to-date ERP system (Kvavik et al., 2002).

The application of an ERP system solution in HEIs assists the decision-making process by interpreting analysis to decisions, data warehousing and giving the HEIs viable advantages (Kvavik and Katz, 2002). Murphy (2004) argued that the ERP platform has not only assisted in effective business methods for the administrators in the HEIs (e.g., improving administration and management, upholding competitiveness and enhancing operation efficiency), but also for students and graduates. In the HEI context, both the virtual learning systems and the student service systems are managed by the ERP system. Such ERP packages are helpful in managing an organisation's internal and external sources to keep a consistent and smooth flow of information within the various business functions of the organisation (Murphy, 2004). Learners may log in to access the system, view the progress they have made academically, relate amongst themselves and capitalise on the opportunities offered through distance learning (Ghuman and Chaudhary, 2012). Additionally, ERP systems make it possible for the higher education society to accomplish fresh levels of knowledge and information in different areas of education (Murphy, 2004). Table 2.2 summarises the benefits of ERP systems in HEIs.

**Table 2.2: ERP Benefits in HEIs.**

<b>ERP Benefits for HEIs</b>	<b>Author(s)</b>
<ul style="list-style-type: none"> <li>• Integrate various administrative systems</li> <li>• Better information flow, enhanced efficiency, increased accessibility for administrative services, improved services for learners and improved access to data</li> <li>• Enhanced business performance</li> <li>• Improved decision making</li> <li>• Uphold competitiveness and enhance operation efficiency, managing internal and external sources and the smooth flow of information</li> </ul>	<p>Rabaa'i et al. (2009)</p> <p>Ahmad et al. (2011)</p> <p>Judith (2005)</p> <p>Kvavik and Katz (2002)</p> <p>Murphy (2004)</p>

<ul style="list-style-type: none"> <li>• Improve knowledge in different areas of education</li> </ul>	Scott and Wagner (2003); Murphy (2004)
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### 2.6.2 The Challenges of ERP Systems in the HEIs

Some research studies indicate that ERP adoption failure is greater in HEIs than in businesses (Blitzblau and Hanson, 2001; Botta-Genoulaz and Millet, 2006; Abugabah and Sanzogni, 2010; Al Kilani et al., 2013). Bologa et al. (2009) evaluated the CSFs for ERP implementation in Romanian universities and compared them to those in industry. They concluded that companies' requirements differ from HEIs and more attention should be given to human and organisational factors. This is because there are different settings regarding information system implementation between for-profit and not-for-profit organisations (e.g., HEIs). Although HEIs share similarities with for-profit organisations, HEIs have unique and particular administrative needs (Pollock and Cornford, 2004).

HEIs are different from conventional organisations because they possess dynamic environments and they mainly use technologies for academic purposes, such as faculties and staff interacting and cooperating for different academic activities (Abbas, 2011). The focus of traditional/industrial ERPs is mainly on basic administrative functions (e.g., operations, marketing, human resources and finance), whereas HEIs need unique and integrated systems that are not part of traditional/industrial ERPs (e.g., course/module administration, timetabling requirements, student administration and virtual learning).

The uniqueness of HEIs stems from various characteristics such as diffuse authority, complexity and internal fragmentation (Lockwood and Davies, 1985). There are two types of authorities within HEIs: academic authority and management authority (Birnbaum and Edelson, 1989). The implementation of an ERP system is believed to strengthen management authority as a "model of governance" (Seo, 2013:19). For managers, this may cause concern with regard to their job security because the system's implementation may eliminate some work functions that have been automated within and across the institution (Allen et al., 2002). In other words, the introduction of the ERP system will

mean that some of that person's role will become automated and therefore their role could be seen to be at risk because they would have less to do. On the other hand, academics could be concerned that the utilisation of the new system could increase the transparency of their transactions, which may lead to a loss of control (Seo, 2013).

According to Ramayah et al. (2007) and Maditinos et al. (2012), the failure of ERP implementation was not related to the ERP software; rather it is caused by the high level of complexity and the tremendous number of changes that ERP systems cause in organisations. This is particularly true for the implementation of ERP systems in HEIs. HEIs are more greatly opposed to change compared to private firms because of the loosely integrated and autonomously functioning administrative and academic units (Gates, 2004), alongside a decentralised authority structure (Rabaa'i et al., 2009). This uniqueness makes it more complex for technological developments to penetrate into the normal schedule of service provision in higher education.

The packaging of ERP systems is often problematic for universities (Bhat et al., 2013). As a result, they are forced either to adjust their operations in order to fit the system or to modify the system to fit their operations (Von Hellens and Beekhuyzen, 2005). Additionally, the complex nature of ERP implementation could cause difficulties for management and the information technology staff in HEIs (Pollock and Cornford, 2004). These difficulties occur when HEIs develop and expand a range of systems with competing functions whenever they had specific requirements. HEIs usually do not have highly experienced management and IT staff in organisational functions, including those who might possess a good understanding of their organisations (Seo, 2013).

Effective communication in HEIs is more important than in private companies (Lechtchinskaia et al., 2011). Heiskanen et al. (2000) suggest that HEIs may be distinguished from private firms because of their peculiar decision-making processes and due to the "hybrid" system of academic and administrative management (Klug, 2009). Each executive member in a faculty can make independent decisions and this element may negatively affect communication processes in the IS choice and its implementation



because of decentralised responsibility and conflicting interests (Sprenger et al., 2010). Sprenger et al. (2010) cite numerous inefficiencies emanating from HEIs' technical, structural and organisational drawbacks; they include poor communication between departments, administrative units and faculties, coupled with a lack of transparency for business processes and responsibilities. Table 2.3 summarises the challenges of ERP systems in HEIs.

**Table 2.3: ERP Challenges in HEIs.**

<b>Challenges Of ERP</b>	<b>Author(s)</b>
• Uniqueness of HEIs	Lockwood and Davies (1985); Pollock and
• Loosely integrated	Cornford (2004)
• Decentralised authority structure	Gates (2004) Rabaa'i et al. (2009)
• Management hierarchy	Allen et al. (2002); Seo (2013)
• Complexity	Ramayah et al. (2007); Maditinos et al. (2012); Bhat et al. (2013); Pollock and Cornford (2005)
• Communication	Sprenger et al. (2010)

### **2.6.3 ERP Adoption in the HEIs in Saudi Arabia: An Overview**

Higher education in Saudi Arabia has experienced a tremendous growth during the past decade. According to Alamri (2011), the higher education system in Saudi Arabia – which is instituted on diversification – has developed to include approximately 24 government universities, 33 private universities and colleges, 80 primary teacher's colleges for women, 18 primary teacher's colleges for men, 12 technical colleges and 37 colleges and institutes for health. Even though the private universities and colleges opened late in the last decade, their numbers have increased dramatically. In 2010, Saudi's Ministry of Higher Education began a new initiative in sponsoring Saudi students who are unable to afford the expenses of local institutions to attend private institutions.

The Gulf region's IT market is dominated by Saudi Arabia; accounting for approximately 3.4 billion US dollars in 2008 and the value was expected to reach 5.6 billion US dollars in 2013 (Market Research Reports, 2009). Numerous local benefits that are inherent in Saudi Arabia may have been utilised in attaining this top position in the world of e-business. These benefits include: the population structure, the communication network, the free economic approaches and the geographical location. In 2010, sixty-nine per cent of Saudi firms were running their operations with ERP systems and these systems have been adopted by 12 out of 24 government-sponsored HEIs in Saudi Arabia (Ministry of Higher Education, 2010; ALdayel et al., 2011).

Table 2.4, below, shows the universities in Saudi Arabia that have adopted ERPs and the year when the systems were adopted. According to Table 2.4, the initial adoption of ERP systems in Saudi Arabia began in 2007 by three universities: KSU, King Fahd University of Petroleum & Minerals and Qassim University. These adoptions were followed by Al-jouf University in 2008 and Hail University and King Abdullah University in 2010. By 2011, the number of universities adopting ERP systems had doubled to include: King Saud Bin Abdulaziz University, Taibah University, Islamic University, King Abdulaziz University, King Faisal University and Shaqra University.

**Table 2.4: Universities that Adopted ERPs in Saudi Arabia (Adapted from ALdayel et al., 2011).**

<b>University Name</b>	<b>Year of Adoption</b>
King Saud University (KSU)	2007
King Fahd University of Petroleum & Minerals	2007
Qassim University	2007
Al-jouf University	2008
Hail University	2010
King Abdullah University	2010
King Saud Bin Abdulaziz University	2011
Taibah University	2011
Islamic University	2011
King Abdulaziz University	2011
King Faisal University	2011
Shaqra University	2011

#### 2.6.4 Studies on ERPs in the HEIs of Saudi Arabia

An extensive search of the literature was conducted by the researcher to locate the studies that are related to ERP systems in HEIs, particularly those in Saudi Arabia. The search was carried out in journals, books, articles and Google Scholar. Table 2.5 provides a list of research studies on the HEI environment in Saudi Arabia that have been extracted by the researcher. The table illustrates topics that were of interest to the different researchers of ERP systems: change management and processes; CSFs; stakeholder performance; technical; and social.

**Table 2.5: A List of Research Studies on the HEI Environment in Saudi Arabia.**

<b>Studies on ERP in HEIs in Saudi Arabia</b>			
<b>Study Focus</b>	<b>Author(s)</b>	<b>Number of Universities</b>	<b>Type of ERP System(s)</b>
<b>Change management strategies and processes</b>	Al-Nafjan and Al-Mudimigh (2011); Al-Shamlan and Al-Mudimigh (2011); Alghathbar (2008)	One	MADAR
<b>Critical success factors (CSFs)</b>	Ullah et al. (2013); ALdayel et al. (2011); Zubair and Zamani (2014); Aljohani et al. (2015); Al-Hudhaif (2012)	One	MADAR
<b>Technical</b>	Al-Mudimigh et al. (2009); Ullah and Al-Mudimigh (2012)	One	MADAR
<b>Stakeholder performance</b>	Althonayan (2013)	Three	Different ERP systems
<b>Social</b>	Agourram (2009)	One	ERP

#### **2.6.4.1 Change Management and Processes**

Al-nafjan and Al-Mudimigh (2011) provided a review of the literature research focusing on ERP change management. The main aim of their study was to investigate and recognise the causes of change management and why organisations' employees resist such changes. Their study was conducted on KSU, which has developed an ERP system called MADAR in order to manage the implementation phase of their ERP system. Al-nafjan and Al-Mudimigh presented the MADAR case study to demonstrate effective strategies for reducing uncertainty and perceived risk with the individuals involved in the transition to new ERP systems. The outcome of their study indicated that the effectiveness of the system (MADAR) to some extent decreases the resistance to change.

Another case study on the same university was investigated by Al-Shamlan and Al-Mudimigh (2011), who investigated the most useful and efficient strategies and significant tools and processes for change management for the successful implementation of an ERP system. In their case study, they also used MADAR to measure the effects on employees after changes in management. The results of their research suggested that both the methods and change management strategies utilised in ERP implementation were effective because the majority of ERP users did not encounter any difficulties in using the systems. Moreover, all of the users believed that the system helped them to accomplish their tasks in an easy way. The authors concluded that the main hurdle that stops users from using the system is their lack of experience in computer and web applications.

Alghathbar (2008) explored the implementation process of the MADAR system at KSU. He outlined some of the positive factors that are required for the correct application of an ERP system, such as user training, data migration and software package selection. He also described the various challenges encountered during the implementation process. Alghathbar highlighted seven challenges or risks pertaining to ERP implementation: lack of expertise, user resistance to change, user inconsistency, technical support weaknesses, slow response from users, data migration and organisation accountability.

#### **2.6.4.2 Critical Success Factors (CSFs)**

In 2013, Ullah et al. presented a case study of ERP implementation at KSU. The main aim of their research was to analyse the CSFs that may affect the success of ERP implementation in HEIs. Several factors were identified and analysed, such as change management, top management support, training and organisation culture. Furthermore, a comparison between the ERP system (MADAR) and the institution's legacy system was conducted. The findings showed that the majority of users have sufficient training to effectively operate the ERP system and were comfortable in using it. Additionally, the study revealed that the ERP system was more accurate and effective than the legacy system.

ALdayel et al. (2011) explored and analysed MADAR implementation in KSU in a bid to identify the CSFs for a successful implementation. The case study measured the success of ERP implementation from both technical and user perspectives; examining 15 CSFs from the technical perspective and three CSFs from the user's perspective. Their research indicated that the most important CSF for the implementation of ERP in the higher education sector in Saudi Arabia was project management. In terms of the top ten CSFs, top management support was ranked as the fifth CSF for the implementation of ERP in the higher education sector in Saudi Arabia. The limitation of their research was that their study was conducted in only one university.

Zubair and Zamani (2014) reported on their case study of one of the universities in Saudi Arabia in order to investigate the factors that may influence ERP implementation. Qualitative research was used to analyse the factors in terms of ERP functions, ERP capabilities and institutional performance. The findings showed that the utilisation of the ERP system is influenced both directly and indirectly by work practice and individuals' acceptance, cultural behaviour and belief in system reliability. In addition, the authors outlined some reasons for system failure that are related to software requirements, as well as to users' acceptance of the technology.

In their case study, Aljohani et al. (2015) attempted to examine some important factors (e.g., public negativity, poor integration, dependency on foreign experts and trend pressure) that may affect ERP replacement in one of the universities in Saudi Arabia. The findings stipulated that HEIs experienced insufficient integration of ERP that policymakers are affected by trend pressure and, finally, that public negativity has an influence on system replacement so that a university can maintain its image and reputation in the market.

Al-Hudhaif (2012) conducted his study on KSU in order to examine the factors that may influence the implementation of ERP from the users' perspective. The main objective of the study was to investigate the situation of MADAR implementation. Both theoretical models as well as hypotheses were developed in order to achieve the study's objectives. The findings indicated that the relationship between ERP implementation challenges and satisfaction levels is significant. However, no significant relationship was found between ERP implementation and user training. In addition, top management support was found to be one of the most critical factors that led to a successful implementation.

There are two main limitations of Al-Hudhaif's research, according to the author. The first is related to the qualitative approach, because the data collection technique would be subject to the interviewer and interviewee's own understanding of technology adoption and would therefore be difficult to replicate. The second limitation is related to the considerably low number of participants, which may therefore negatively affect the reliability of the provided information.

#### **2.6.4.3 Technical**

Al-Mudimigh et al. (2009) examined the application of data mining on ERP system (MADAR) data. The focus of the case study was on the organisation development and the improvement of customers' satisfaction at KSU. The authors utilised the ERP-CRM model using a data-mining approach and applied it on ERP (MADAR) data. Clustering and the Apriori Algorithm were used to discover the patterns from the experienced data.

The results of their research suggested that the developed model has the ability to resolve customers' complaints and satisfy their needs.

Another case study was investigated by Ullah and Al-Mudimigh (2012) to investigate the integration and collaboration of different departmental activities within KSU. The main objective of their research was dedicated to eliminating inconsistent data in the ERP system (MADAR). The case study suggested techniques to detect inconsistencies in the data before it occurred. The study outcomes indicated that the best solution to fix data inconsistency is through collaboration and the internal departmental integration of top management in the organisation.

#### **2.6.4.4 Stakeholder Performance**

Althonayan (2013) proposed a theoretical framework to evaluate stakeholders' performance of ERP systems in HEIs in Saudi Arabia. The main purpose of her study was to develop an integrated model by utilising different IS success models. The study's results showed that both service quality factors and system quality factors have positive influences on stakeholders' performance, as well as on their productivity. According to the author, there are several limitations to the study that should be addressed; for instance, the focus of the study was only on one ERP phase (post-implementation) and HEIs in Saudi Arabia require adequate time to evaluate the implementations of their ERP systems.

#### **2.6.4.5 Social**

Another case study conducted by Agourram (2009) investigated the perceptions of IS success by managers who worked for a public university in Saudi Arabia. The research results showed that users' perceptions of IS performance and success were only at the system level, while users' perceptions at the organisational and individual levels are not understood. According to the author, the perceptions of IS success are influenced by culture, which may in turn affect ERP implementation.

## **2.7 GAPS IN THE FIELD OF ERP ADOPTION STUDIES IN HEIS IN SAUDI ARABIA**

The above research topics address some of the gaps in the field of ERP adoption studies in HEIs in Saudi Arabia as follows:

- It is notable that the focus of the majority of these studies was dedicated to address the technical aspects, the implementation process and the CSFs, rather than the social aspects. These may not highlight whether ERP adoption is effective or ineffective for a particular user within a given environment. In fact, because the number of available ERP systems are increasing and because many HEIs are adopting them, it is therefore necessary for new research studies to investigate various issues in this context. Howcroft and Wagner (2004) advise that it is important for research studies to focus on the use of ERP systems both across and within contexts.
- There is enough evidence in the IS literature that system users were not included in the system evaluation process, particularly in research studies that have investigated technical factors rather than human characteristics (Khalifa et al., 2005). Despite the capability of the CSF approach to evaluate ERP systems, such an approach is incapable of providing a means of evaluation or ensuring the success of technology implementation (Althonayan, 2013). The implementation of an ERP system cannot be considered successful unless the users' attitudes toward the system are positive and match their expectations (Al-Mashari, 2003). Sandhu et al. (2013) argue that the acceptance of ERP systems is one of the CSFs that contribute to the success of ERP implementation.
- According to the above studies (e.g., Al-Shamlan and Al-Mudimigh, 2011; Zubair and Zamani, 2014), the main reason for ERP failure in HEIs in Saudi Arabia was either the resistance of users to change or the unwillingness of users to accept the



new technology. Another study (Agourram, 2009) indicated that the users' perceptions at both the organisational and the individual level are not understood. Thus, research studies should place emphasis on examining the ways that ERP systems are adopted and utilised by individuals, and more attention should be given to this aspect because it may influence the use of the ERP system that forms the attitude as well as the behaviour of the system users.

- None of the research studies provided clear instructions for the effective adoption of ERP systems in HEIs and that there is a lack of research investigating the adoption of ERP systems in the HEI environment. In addition, there is inadequate research that attempts to develop a conceptual framework (which is the focus of this research) for the adoption of ERP systems in HEIs from the users' technology acceptance point of view, despite the fact that HEIs are still adopting ERP systems.
- It is obvious that the majority of the research studies on ERP systems in Saudi Arabia were conducted on one university (KSU) and on one type of ERP system (the MADAR system). MADAR is an ERP software system that was locally developed at KSU in Saudi Arabia in order to meet budget constraints. However, this system cannot be considered to be a global ERP system like Oracle E-Business Suite and SAP systems. Thus, the research results may differ from the experiences of other HEIs that have adopted global ERP systems. There is, therefore, a need for more research studies to consider more ERP systems and more users' opinions from different universities in Saudi Arabia.

## **2.8 SUMMARY**

This chapter provides a general overview of the theoretical background of ERP adoption. It describes in detail the different aspects of ERP adoption both in general and in HEIs in particular. The main purpose of this chapter was to investigate the current adoption of ERP systems by HEIs located in Saudi Arabia. The review undertaken reveals some of

the gaps in the field of ERP adoption studies in HEIs that this thesis aims to address. It was notable that the focus of the majority of these studies was dedicated to address the technical aspects, the implementation process and the CSFs rather than the social aspects. Furthermore, none of the reviewed research studies have provided clear instructions for the effective adoption of ERP systems in HEIs and there is a lack of research that has investigated the adoption of ERP systems in the HEI environment.

There is also inadequate existing research that attempts to develop a conceptual framework (which is the focus of this research) for ERP adoption in HEI from the users' technology acceptance point of view, despite the fact that HEIs are still adopting ERP systems. Moreover, the majority of the research on ERP systems in Saudi Arabia was conducted on one university (KSU) and in one type of ERP system (the MADAR system). There is, therefore, a need for more research to consider more ERP systems and more users' opinions from different universities in Saudi Arabia.

As the overall aim of this research is to develop a model of factors affecting the adoption of ERP systems in HEIs, ERP adoption will be studied from the point of view of information system acceptance. Therefore, the next chapter (Chapter Three) aims to develop a theoretical framework for ERP adoption by HEIs, and will do this by examining the various technology adoption frameworks that pertain to the acceptance of technology.

## **CHAPTER THREE: DEVELOPMENT OF A THEORETICAL ERP ADOPTION FRAMEWORK**

### **3.1 INTRODUCTION**

In Chapter Two, the shortage of research on the adoption of ERP in HEIs in Saudi Arabia was made evident. It was also shown that the existing research studies in Saudi Arabia have not attempted to develop a conceptual framework for ERP adoption in HEIs, despite the fact that HEIs are still adopting ERP systems. The main aim of this chapter (Chapter Three) is to develop a theoretical framework for ERP adoption in HEIs. Thus, this chapter discusses various technology adoption frameworks that pertain to the acceptance of technology. In reference to that, studies that have generally drawn on TAM – specifically in the ERP context – are presented. The main factors that have an effect on the adoption of ERP systems are then discussed and the research's proposed model, questions and hypotheses are developed before the chapter is finally summarised.

The main aims of this chapter are:

1. To gain an understanding of the existing theories and models in the field of users' acceptance of technology.
2. To identify existing evidence that may lend support to the proposed model structure.
3. To choose the baseline model (TAM) that is used to determine the important factors that may affect the adoption of ERPs by HEIs.
4. To establish a conceptual framework in order to design the research questionnaire.
5. To identify the initial set of indicators (observed variables) for each latent variable in this study.
6. To develop the proposed model of the research.

### **3.2 INFORMATION TECHNOLOGY ADOPTION FRAMEWORKS**

There are several researchers in the IT community that have investigated the adoption of IT in general (Grandon and Pearson, 2004). Literature that pertains to information systems is comprised of a myriad of models that try to explain the use or acceptance of IT. The most common models that have been developed to explain the adoption and acceptance of IT systems include: Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA); Ajzen's (1985) Theory of Planned Behaviour (TPB); Rogers' (1983) Innovation Diffusion Theory (IDT); Davis' (1986) Technology Acceptance Model (TAM); and Venkatesh and Davis' (2000) theoretical extension of TAM (referred to as TAM2).

#### **3.2.1 Theory of Reasoned Action (TRA)**

The TRA model was first developed by Fishbein and Ajzen (1975) and it is used in the explanation and prediction of human behaviour. Fishbein and Ajzen's (1975) study was derived from the social psychology setting and was focused on attitude and behaviour. According to Fishbein and Ajzen, an individual's behavioural intention is based on the interaction of attitude and the subjective norm. The attitude (personal factor) is defined as "an individual's degrees of evaluative effect toward the target behaviour" (Fishbein and Ajzen, 1975:216). The subjective norm (social factor) is defined as "the person's perception that most people who were important to him think he should or should not perform the behaviour in question" (Fishbein and Ajzen, 1975:302).

The TRA model demonstrates that an individual's behaviour (B) can be considered a positive function of an individual's behavioural intention (BI) to perform the behaviour. TRA is comprised of subjective norm (SN), attitude (A) and behavioural intention (BI). According to TRA, the behavioural intention of a person depends on the attitude of a person about subjective norms and behaviour. A person can perform a behaviour if he/she intends to. "The theory views a person's intention to perform a behaviour as the immediate determinants of the action and since the purpose of the theory is to understand human behaviour, therefore, it is essential to identify what determines intentions" (Ajzen and Fishbein, 1980:6).

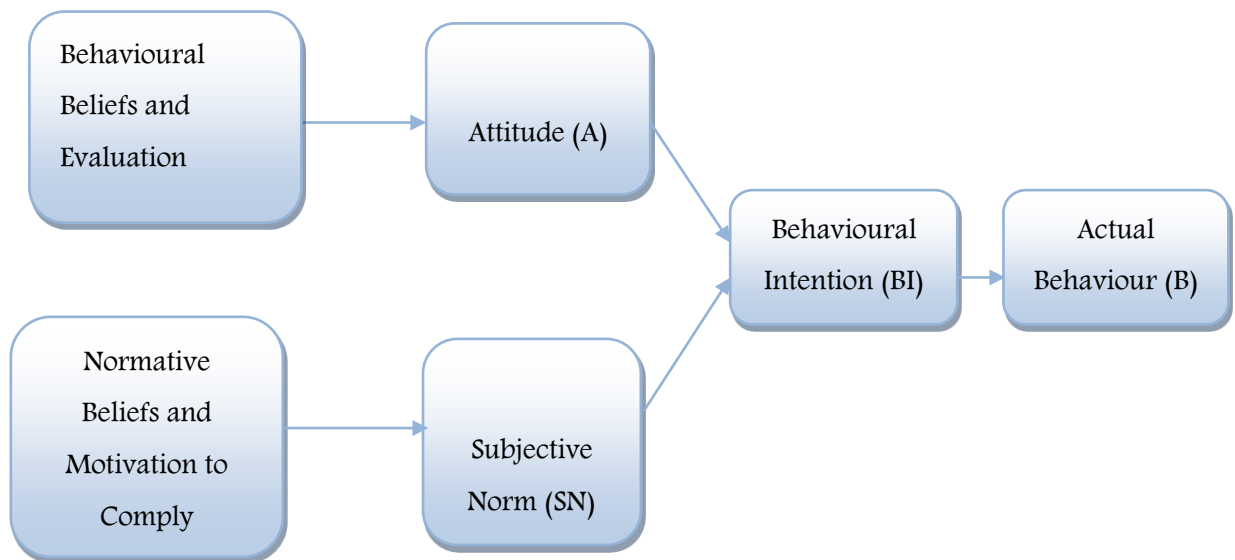
Behavioural intention measures the relative strength of a person to perform a behaviour. Attitude is made up of a person's beliefs on the consequences of executing the behaviour, multiplied by the evaluation of the consequences. Subjective norm is a combination of expectations (normative beliefs) that individuals expect upon compliance. It implies that a person has a perception of whether important people think he or she should perform the behaviour. Fishbein and Ajzen (1975) also point out that both the attitude and beliefs of an individual are supported by subjective norm factors that ultimately determine an individual's behavioural intention (see Figure 3.1). When relating the TRA to the adoption of ERP, the use of an ERP system would be influenced both by the employees' beliefs concerning the positive and negative consequences of using an ERP system and the normative beliefs (perceived expectation of the referents) about what people important to the employees were believed to think about the use of the ERP system.

The TRA model has been adopted by different research studies and applied to various topics, such as: e-commerce (Korzaan, 2003; Pavlou, 2003), online purchasing (Korzaan, 2003), technology acceptance (Al-Gahtani and King, 1999), brand loyalty (Ha, 2004) and apparel shopping (Yoh et al., 2003). In the field of IT adoption, Korzaan (2003) used the TRA in the context of e-commerce and online purchasing. The results showed that attitude is a direct and significant influence of intention to engage in online purchasing transactions. In addition, Pavlou (2003) applied the TRA/TAM in the e-commerce domain and concluded that the TRA and TAM are robust models in the e-commerce context. Similarly, Al-Gahtani and King (1999) concluded that TRA and TAM together provided better explanatory power. Wu et al. (2003) utilised the TRA model in order to determine the factors that may affect the acceptance of technology in the re-engineering process. They found that the subjective norm can be considered an important factor for IT acceptance.

Different researchers (Succi and Walter, 1999) have indicated that there is a strong relationship between users' acceptance of technology and their attitudes to use that technology. In other words, the more accepting the user is of the technology, the more

likely they are to be willing to invest time and effort into using it. In addition, Davis et al. (1989) offered a further explanation of TRA in terms of technology adoption. They confirmed that an individual's adoption and utilisation of IT innovation is eventually influenced by his/her beliefs and attitude toward IT systems.

Originally described as having been designed to explain virtually any human behaviour (Ajzen and Fishbein, 1980), TRA was intended to be a very general theory and, thus, does not specify which beliefs are effective for a particular context. Therefore, it is important for researchers using TRA to first identify the types of beliefs to be included in the situation being addressed (Ajzen, 2002). Moreover, the TRA model stems from the assumption that behaviour can be controlled and therefore involuntary behaviours are not described or made clear by this model (Ajzen and Fishbein, 1980). Ajzen and Fishbein (1980) mentioned three categories of external variable: demographic variables, personality traits and attitude toward organisational targets. However, they did not include external factors in the TRA model. Several researchers advise, therefore, that the TRA model needs extra explanatory factors (Thompson et al., 1991).



**Figure 3.1: Theory of Reasoned Action (TRA).** Source: Fishbein and Ajzen (1975)

### **3.2.2 Theory of Planned Behaviour (TPB)**

The theory of planned behaviour (TPB) was established by Ajzen (1985) and can be considered to be an expansion of the TRA model (Fishbein and Ajzen, 1975). According to TPB, behaviour is an important factor that affects behavioural intention. There are strong similarities between the TRA model and the TPB model. For instance, intention is influenced by the subjective norm and attitude in both models. The main difference between TRA and TPB, however, is a new variable known as perceived behavioural control (PBC) that was added to the TPB model. As illustrated in Figures 3.2 and 3.3, the addition of actual control and PBC to TPB are the core reasons why the theory is at variance with TRA.

Prior research by Ajzen and Mandal (1986) and Sparks et al. (1992) indicated that there is a positive association between PBC and control beliefs. For the empirical case of technology acceptance, PBC is referred to as the perceived degree of control an individual has over his/her performance on the behaviour and the availability of adequate resources (e.g., time, money and physical abilities) to do a particular behaviour (Ajzen and Mandal, 1986). Ajzen (1985) asserts that PBC represents the peoples' convictions pertaining to the accessibility of resources and the opportunities required when executing the behaviour, or alternatively to the inner and peripheral variables that can thwart the execution of a given behaviour.

In Ajzen's TPB, PBC was explicated as a function that stems directly from behavioural intention. As illustrated in Figure 3.3, the theory also explained that behavioural intention comes from an individual's attitude, their subjective norm and their perceived behavioural control. In a nutshell, behaviour (B) in Ajzen's theory was a weighted summation of behavioural intention (BI), as well as PBC. However, BI was weighted as a summation of an individual's attitude (A) and his/her subjective norm (SN), as well as the constituents of PBC.

TPB can be divided into two versions: first, the traditional version that is illustrated in Figure 3.2 and, second, the decomposed version (DTPB) that is illustrated in Figure 3.3.

According to Taylor and Todd (1995), in order to achieve a clear comprehension of the correlation between the belief and antecedents of intention, the constructs of TPB need to be decomposed into components that are more in depth and exhaustive. Based on this argument, Taylor and Todd (1995) drew references from IDT (Rogers, 1983) to break down the attitude concept of TPB into relative advantage, complexity and compatibility.

Relative advantage can be explained as the degree of superiority an innovation is perceived to have compared to its antecedent, and it ought to be positively correlated to that rate at which an innovation is adopted (Rogers, 1983). According to several research studies (Rogers, 1983; Lee et al., 2004; Wu and Wu, 2005), relative advantage is one of the critical factors of IDT that have a positive influence on the adoption of innovations. Complexity, on the other hand, can be explained as the degree of difficulty in usability that an innovation is perceived to have (Rogers, 1983). Innovations that are deemed to be user-friendly and less intricate have a higher chance of being accepted by potential users. This is because innovations that are deemed too complex by the users result in negative attitudes. Finally, compatibility can be explained as the degree of harmony an innovation is perceived to have with the potential users' current values, requirements and experiences (Rogers, 1983). Several research studies support the positive relation between innovation adoption and compatibility of the system (Premkumar, 2003; Wu and Wu, 2005; Tung et al., 2009).

Innovations that are in harmony with the users' needs are more likely to be adopted. As illustrated in Figure 3.3, facilitating conditions and self-efficacy are two components of PBC. Facilitating conditions refers to the ease of access to the resources required to behave in a particular manner (Triandis, 1979), whilst self-efficacy refers to the confidence and aptitude to successfully behave in that particular manner in its circumstance (Bandura, 1982).

Taylor and Todd (1995) demonstrated that the explanatory power of DTPB is much higher than that of pure TPB and TRA. DTPB has been applied in numerous disciplines, such as



internet banking (Shih and Fang, 2006; AL-Majali et al., 2010), e-service (Hsu and Chiu, 2004), m-coupons (Hsu et al., 2006) and e-purchasing (Fitzgerald and Kiel, 2001).

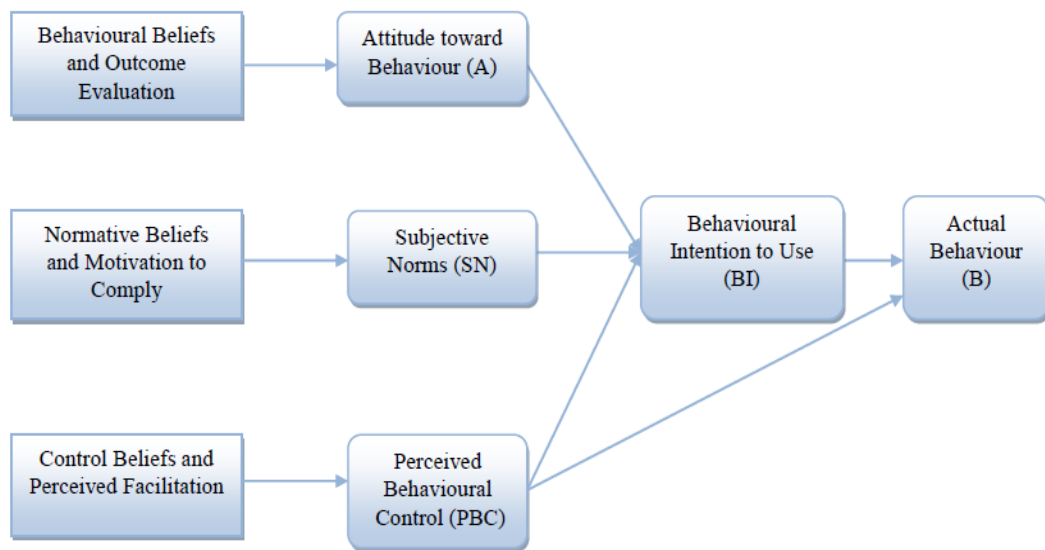
Mathieson (1991) articulates that the application of TPB in the adoption of new technologies has been immensely facilitated by organisational psychologists in the field of IT. TPB has been used in a number of studies in the field of IT to evaluate technology acceptance. Hsu et al. (2006) used the TPB model in order to examine individuals' intention and found that users' satisfaction was an important indicator of intention to use technology. In a similar study by Harrison et al. (1997), TPB was applied in order to evaluate how IT was being adopted in SMEs. According to this study, an individual's attitude, subjective norms and PBC are all significant determinants in the adoption of IT in SMEs.

Another example study found out that individuals' intention to use a technology is affected by user's satisfaction, which is also influenced by both their perceived quality and usability of the IT systems (Roca et al., 2006). TPB was also applied by Morris and Venkatesh (2000) to evaluate how age differences affected the adoption of technology. It was established that the adoption of technology among younger individuals was dependent on their attitudes, whilst in older people it was dependent on their subjective norms.

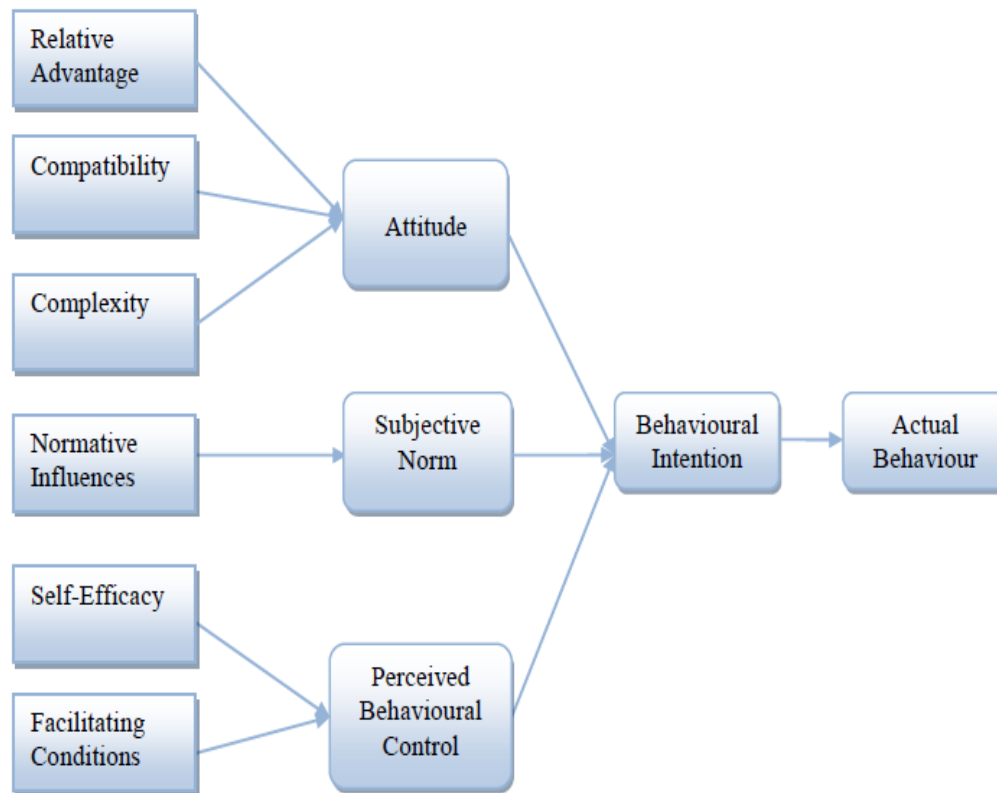
Some studies embarked on combining TPB and TAM models in order to study technology acceptance. However, such research studies provide different findings. For example, Park (2004) found that both attitude and perceived usefulness have an influence in predicting technology acceptance. This finding was also supported by Igbaria (1993). On the other hand, Bansal and Taylor (2002) revealed that both subjective norm and attitude have an influence in predicting technology acceptance. This finding was also supported by Terry et al. (2000).

Despite the fact that TPB is a well-established model, it ignores both demographic and cultural effects on user behaviour (Manoi, 2007). According to TPB, individuals'

behaviours are planned; however, the model has failed to show how such planning is related to the model and does not explain how individuals plan toward such behaviours. Additionally, the model utilises the PBC variable in order to examine uncontrollable elements of behaviour. However, from a psychometric point of view, subjective norms – which can be considered as uncontrollable elements of behaviour – may not have any impact on behavioural intention, particularly in voluntary usage (Davis et al., 1989).



**Figure 3.2: Theory of Planned Behaviour (TPB).** Source: Ajzen (1985).



**Figure 3.3: Decomposed Theory of Planned Behaviour (DTPB).** Source: Taylor and Todd (1995).

### 3.2.3 Innovation Diffusion Theory (IDT)

Chen et al. (2000) consider that IDT is among the key theories used in innovation technology because one can use it to forecast the rate at which an innovation will be espoused. IDT was established by Rogers in 1962 in a bid to explain the manner in which an innovation is diffused. According to Rogers (1995:5), innovation refers to “a new programme, initiative or technology that is introduced to consumers, while diffusion is the gradual communication of an innovation through particular channels to potential consumers”.

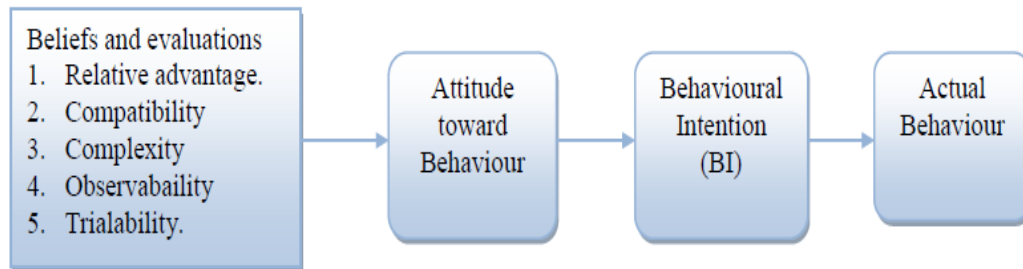
Rogers (1995) suggests that the process of adoption of an innovation takes place in five phases: knowledge, persuasion, decision, implementation and confirmation. In the knowledge phase, the consumer is exposed to the innovation so that they can begin to get

acquainted with it. In the persuasion phase, the user's attitude towards the innovation is swayed by an influential party. In the decision phase, the user makes a choice to either adopt or reject the innovation. If the choice to adopt is made, then the implementation phase is where the users put the innovation into practice. In the final phase, confirmation, the decision phase is revisited and the user decides whether to accept or reject their original decision to adopt the innovation. Rogers' five phases of IDT are in harmony with Aggarwal's (2000) argument that IDT explicates the gradual adoption of an innovation.

Rogers also identified five categories into which an adopter can be placed based on their innovativeness: the innovators, early adopters, early majority, late majority and the laggards. Rogers also classified innovative decisions into three categories: optional innovation decisions, collective innovation decisions and authority innovation decisions.

According to Rogers (1983), there are five factors that influence the adoption of innovations (Figure 3.4):

1. Relative advantage – this is the degree of superiority an innovation is perceived to have compared to its precursor.
2. Compatibility – this is the degree of harmony an innovation is perceived to have with the potential consumers' current values, requirements and experiences.
3. Complexity – this is the users' perceived degree of difficulty with regards to the usability of an innovation.
4. Observability – this is the degree to which the outcome of an innovation is visible and discernible.
5. Trialability – this is the degree of empirical and experimental capacity an innovation has before it is adopted.



**Figure 3.4: Innovation Diffusion Theory (IDT).** Source: Rogers (1983).

According to Chen et al. (2000), the five factors identified by Rogers have been drawn upon by numerous studies that have delved into the diffusion of innovation. The concepts of IDT have been used in numerous areas, including e-procurement (Fitzgerald and Kiel, 2001), e-banking (Khalil and Pearson, 2007), smart card payment platforms (Plouffe et al., 2001) and the adoption of e-commerce (Mirchandani and Motwani, 2001).

In terms of the acceptance of IT, Speier and Venkatesh (2002) presented an in-depth model to investigate the perceptions that influenced people's decision to adopt a technology. Additionally, elements of Rogers' model have also been integrated in a number of studies aimed at delving into innovation in technology (such as: Daniel, 1999; Howcroft et al., 2002; Lee, 2006). Some elements of IDT were tested by Al-Gahtani (2003) in his study, which was aimed at evaluating how computer technology was being adopted among Saudi workers. The concepts of TAM/TAM2, IDT and TPB/TRA were combined and merged by Hardgrave et al. (2003) in order to establish a model that could forecast the intention of using automated drug storage gadgets (referred to as automated dispensing machines). Another study by Khalil and Pearson (2007) employed the IDT model to assess the factors that may affect the user adoption of electronic banking in Malaysia. The results of their research indicated that attitude has a significant effect on user acceptance of the technology.

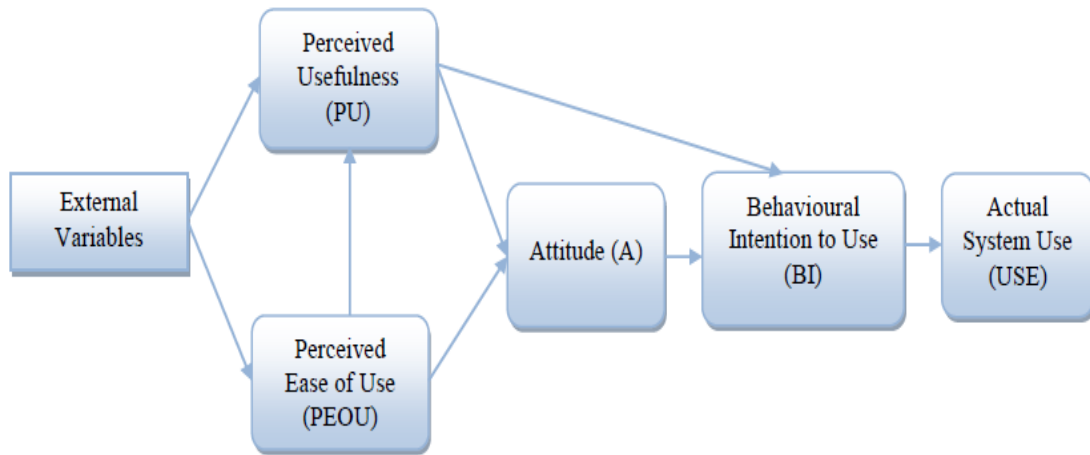
The limitations of IDT stem from its weakness of not reliably examining constructs (Agarwal and Prasad, 1999). The model also does not take into consideration the influence of demographic factors such as age and gender on users' attitude toward IT acceptance. In addition, Agarwal and Prasad (1999) claimed that the definition of IDT variables has methodological limitations.

### **3.2.4 Technology Acceptance Model (TAM)**

Davis (1986) is deemed as the proponent of TAM, which is a derivative of TRA purposely fashioned to generate user acceptance of IT. TRA asserts that beliefs sway attitudes, which then bring about intentions and finally generates behaviour. TAM adopted this belief–attitude–intention–behaviour relationship to model user acceptance of IT. According to Taylor and Todd (1995), TAM can be viewed as a unique case of TRA that is devoid of the subjective norms and beliefs (i.e., PU and PEOU) that determine attitude.

Subjective norm is not viewed as a factor that influences behavioural intention in TAM because, during the evaluation of acceptance using the model, the subjects are not given information regarding the expectations of their most important referents (Davis, 1986). According to Fishbein and Ajzen (1975:304), another reason why subjective norm “is not viewed as a factor that influences behavioural intention in TAM is because it is one of the least understood factors affecting TRA”. Nonetheless, Davis' study (1989) incorporated subjective norm in an attempt to evaluate TRA and test if subjective norm brings about any difference in behavioural intention past that justified by attitude and perception of usefulness.

TAM's objective, according to Davis (1989), is to provide a foundation for evaluating how internal beliefs, attitudes and the intention of using technological gadgets (such as computers) is affected by external factors. As illustrated in Figure 3.5, the TAM model hypothesises that two specific beliefs – PU and PEOU – are of the utmost significance in the determination of computer acceptance behaviours.



**Figure 3.5: Technology Acceptance Model (TAM).** Source: Davis et al. (1989).

Davis (1986:26) explains PU as “the degree to which an individual believes that using a particular system would enhance his or her job performance”. PEOU – as explained by Davis (1986:82) – is “the degree to which an individual believes that using a particular system would be free of physical and mental effort”.

Just like TRA, TAM proposes that actual system use (USE) is contingent on behavioural intention. Unlike TRA, however, the behavioural intention in TAM is mutually dependant on the person’s attitude as well as his perception of the system’s usefulness, whereby the relative weights are approximated by means of regression. Davis (1986) came up with a symbolic representation of these assertions in the following equations:

$$USE = W1 BI + e$$

$$BI = W2 A + W3 PU + e$$

Where: USE represents the actual system use; BI represents the individual’s behavioural intention; A represents the individual’s attitude toward performing a behaviour; PU represents the individual’s perception regarding the usefulness of the system; W1, W2, W3, W4 and W5 represent the importance weights; and e represents the random error term.

In TAM, the A–BI correlation implies that people’s attitudes are important in the determination of their behavioural intention. The PU–BI correlation, on the other hand, is founded on the notion that people’s behavioural intention of adopting a system is determined by their belief that the system will be important in improving their performance in the workplace. Davis (1989) asserts that this notion is based on the knowledge that improved performance in the workplace is essential in the acquisition of several extrinsic incentives like salary increment and promotions. Moreover, the person’s attitude in TAM is mutually dependent on both PU and PEOU, whereby their relative weights are approximated by means of linear regression. Davis (1986) came up with a symbolic representation of these assertions in the following equation:

$$A = W1 PU + W2 PEOU + e$$

Where: A represents the individual’s attitude toward performing behaviour; PU represents the individual’s perception regarding the usefulness of the system; PEOU represents the individual’s perception regarding user-friendliness of the system; W1 and W2 represent the importance weights; and e represents the random error term.

The general assumption in TAM is that both BI and A are directly affected by PU. Another assumption made is that A is significantly affected by PEOU. There are two basic mechanisms through which PEOU affects users’ attitudes and behaviours: self-efficacy and instrumentality. If a system is deemed easy to handle, then the user gains a sense of self-efficacy (Bandura, 1982), as well as personal control pertaining to his/her capacity to perform the technicalities required to manoeuvre the system’s functions (Lepper, 1985). Furthermore, enhancements in PEOU can be instrumental in augmenting a person’s performance in the workplace. As a result, PEOU can be enhanced in the workplace in order to enable the employees to perform more tasks with the same effort. However, efficacy in TAM functions independently from the factors that instrumentally affect behaviour and influences impacts, persistence of effort and motivation as a result of the inherent drives that motivate people to be competent and self-determined (Bandura, 1982).



In addition to improving performance in the workplace, enhanced PEOU also directly affects PU. Davis (1986) asserts that other than PEOU, PU is also affected by a myriad of external variables, as demonstrated in the following equation:

$$PU = W_{n+1} PEOU + \sum_{i=1, n} W_i X_i + e$$

Where: PU represents the individual's perception regarding the usefulness of the system; PEOU represents the individual's perception regarding user-friendliness of the system;  $X_i$  represents external variable  $i$ ,  $i = 1, n$ ; and  $W_i$  and  $W_{n+1}$  represent the importance weights.

According to Davis (1986), the equation that shows how the external variables affect PEOU is as follows:

$$PEOU = \sum_{i=1, n} W_i X_i + e$$

Examples of the external factors that affect PEOU, according to Davis (1989), include: user support consultants, training and documentation. Most of the features in systems – for example, menus, icons and touch screens – are installed to boost user's ease of use and, according to Davis (1989), the effect of such features on PEOU is significant. According to Venkatesh and Davis (2000), PU has been identified as a significant factor that affects the usage intention in tests performed using TAM, whereby the standardised regression coefficients are usually approximately 0.6.

According to Lee et al. (2003), TAM can be used to analyse acceptance of a myriad of IT systems among users. Stoel and Lee (2003) mention that the original TAM has been heavily drawn upon in previous studies in the evaluation of acceptance of IT systems among users. The TAM model has been employed in various IT systems, such as: e-government (Chooprayoon, 2012), mobile-learning (Cheon et al., 2012; Iqbal and Qureshi, 2012), internet (Moon and Kim, 2001; Brown, 2010), e-auction (Yousafzai and Yani-de-Soriano, 2012), e-library (Jeong, 2011), e-portfolio systems (Cheng et al., 2015), e-banking (Abbad, 2013) and e-learning (Cheung and Vogel, 2013).

The development of the original TAM was based on two major studies that were carried out by Davis (1989) and Davis et al. (1989). Davis' first study (Davis, 1989) – which involved 152 subjects – was based on his 1986 dissertation. The study investigated the acceptance of application programs – such as XEDIT, email, PENDRAW and Chart-Master – between the 152 study subjects. The study specifically concentrated on four factors that influence user acceptance: PEOU, PU, intention to use and computer usage. The findings of the study implied that PU greatly affected intention and that intention was a great determinant of computer usage. The findings also implied that usage behaviour was contingent on the user's behavioural intention.

Davis' second study, which was conducted by Davis et al. (1989), entailed modifications of the first model to include attitudes and subjective norms as factors that influence user acceptance. The findings of this study implied that over half of the users' intention to use was heavily influenced by PU. PEOU was found to have a small but substantial impact on intention to use. On the other hand, attitude was only found to partially mediate the impacts of PU and PEOU on intentions and the intention to use was not impacted by subjective norms. Davis et al. (1992) argued that both extrinsic and intrinsic factors of motivation influence user intention. They continued to state that PU was a form of extrinsic motivation that heavily influenced the adoption of IT systems.

TAM and both its main constructs – PU and PEOU – proved its validity at foretelling user acceptance behaviour and intention across different types of technologies (Piaggese et al., 2011; Carayannis, 2013). For example, according to the longitudinal study conducted by Venkatesh (2000), to investigate the determinants of PEOU. The findings of the study indicate that TAM elucidates approximately 40 per cent of the variance in behaviour, as well as usage intention. In the e-learning environment, Park (2009) employed TAM to examine students' perceptions of e-learning systems. The findings of the study indicated that students' perception of e-learning systems is affected by subjective norms and system accessibilities. In the e-banking sector, Cheng et al. (2006) employed TAM to examine

consumers' willingness to use the systems. The results showed that TAM has the capability to predict users' behavioural intentions.

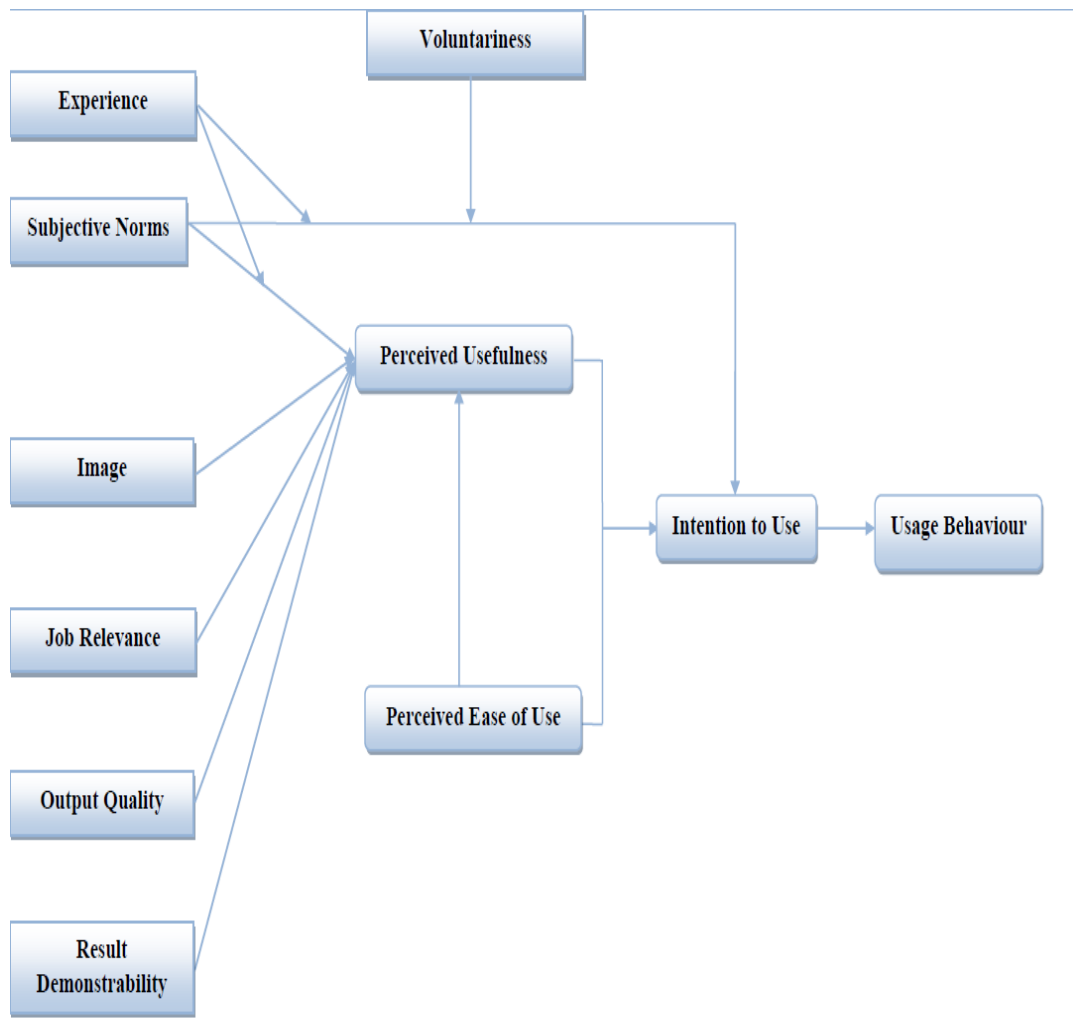
### **3.2.5 Modified Technology Acceptance Model (TAM2)**

Before Venkatesh and Davis (2000) made a few adjustments from TAM to TAM2, the correlation between different aspects of technology acceptance had been explored for over ten years. As Venkatesh and Davis (2000) stipulate, during this time PU became consistently acknowledged as one of the strong factors that influence usage intentions, whereby the standardised regression coefficients are usually approximately 0.6. As a corollary, Venkatesh and Davis (2000) broadened their model to take account of subjective norms, image, relevance of the job, quality of output, demonstrability of results, as well as PEOU as an antecedent of PU – as illustrated in Figure 3.6. The antecedents of PU formed the core difference between TAM and TAM2. In TAM2, the major forces that influenced judgments of PU were meticulously expounded, whereby 60% of the differences in behavioural intention (BI) were explicated. In addition, user's attitude was dropped in TAM2, and BI and usage behaviour were regarded as the ultimate dependent variables.

The determinants of PU in TAM2 take account of both social and cognitive factors. Subjective norms, voluntariness and image are the social factors that affect PU in TAM2. Voluntariness, according to Venkatesh and Davis (2000), can be defined as whether the user is directed to use the system or whether he/she uses it out of freewill. Voluntariness standardises the impact of subjective norms on a person's intention to use IS technologies. Consequently, when usage of an IS technology is mandatory, the subjective norms will bring about a positive impact on intention to use the system. When usage is out of freewill, subjective norms will have no impact. Image reflects whether usage is perceived to enhance the social perception of the user (Venkatesh and Davis, 2000). The PU of an IS technology is said to be positively impacted by image and subjective norms. As a result, TAM2 looks into these relationships based on the user's experience. According to the model, the subjective norms of a user will have less effect on the PU and usage intention if the user becomes progressively exposed to the IS technology.

Relevance of the system in the job, quality of output and the demonstrability result are the cognitive determinants of PU. Job relevance, according to Venkatesh and Davis (2000), can be defined as a user's perception regarding the applicability of the IS technology in the work. On the other hand, output quality is defined by Venkatesh and Davis (2000) as the users' perception regarding the system's effectiveness when performing specific tasks. Finally, Venkatesh and Davis (2000) define result demonstrability as the tangibility of an IS technology on performance or contribution. Every cognitive determinant is said to have a positive effect on the PU of an IS technology.

Chau and Lai (2003) applied TAM2 in the evaluation of users' acceptance of e-banking. They established that PU was a significant determinant of BI, but found no significant correlation between PEOU and acceptance. Hart et al. (2007) applied TAM2 to investigate a practical online analytic processing (OLAP) project for students. Based on the findings of the study, it was apparent that there is indeed a positive correlation between cognitive factors such as demonstrability of outcomes, quality of output and job relevance, as well as PEOU and acceptance of IT systems.



**Figure 3.6: Modified Technology Acceptance Model (TAM2).** Source: Venkatesh and Davis (2000).

TAM has received sufficient attention in the literature, but not without criticism. For instance, the original version of TAM lacks rigorous and sufficient research (Chuttur, 2009). Another criticism noted by Segars and Grover (1993) was regarding TAM's utilisation of CFA to re-construct another model using different variables (e.g., ease of use and usefulness). For over two decades, different research studies have attempted to extend TAM's theoretical basis to overcome some of the mentioned drawbacks. For instance, results of extending the original TAM to TAM2 (proposed by Venkatesh and Davis, 2000) significantly supported the model formulation. Furthermore, other researchers (such as Jiang et al., 2000; Chau and Hu, 2001; Horton et al., 2001) have

modified TAM to suit new technologies, including internet, intranet and World Wide Web (WWW). In addition, several studies extended TAM by focusing specifically on antecedents of PEOU and PU (Venkatesh, 2000; Pavlou, 2003), or added additional components to the model – such as perceived self-efficacy (Al-Gahtani and King, 1999; Venkatesh and Morris, 2000; Kleijnen et al., 2004) – in order to account for their studies' context.

Mathieson (1991) compared TAM and TRA in a study of spreadsheet acceptance. The results indicated that PEOU and PU were significant factors that affected usage. Moreover, Igbaria et al. (1997) described the TAM model as easier, much simpler and more accurate than the TRA model when examining technology acceptance. Taylor and Todd (1995) also made a comparison of TAM, TPB and DTPB and established that TAM had been successful in predicting the use of a computer resource centre. This was vital in adding to the growing support for the model.

In a meta-analysis of 26 studies, carried out by Ma and Liu (2004), a conclusion was made that there was a strong and significant correlation between PU and acceptance, as well as between PU and PEOU. Furthermore, Sun et al. (2009:351) stated that:

[M]uch prior IT usage research was based on Ajzen's theory of planned behavior (TPB), shaped by three perceptions: attitude, subjective norm (SN), and perceived behavioral control (PBC). Though it did not identify specific beliefs or other perceptions salient to IT usage, TAM added perceived usefulness (PU) and perceived ease of use (PEOU) as attitudinal beliefs salient to IT usage.

Despite the limitations of the different frameworks that have been discussed in the previous subsections, some may wonder why not utilise another model – such as technology–organisation–environment (TOE) or DeLone and McLean's (1992) IS success model – instead of using TAM? Despite these models having been used to develop frameworks and conceptual models in order to understand the relationship of various

factors that may affect ERP adoption, it is worth noting that the previous research on some of these models – such as DeLone and McLean’s (1992) IS success model – have not been empirically proven (Seddon, 1997).

The reasons for adopting ERP systems are different from other traditional information systems. Indeed, Ifinedo et al. (2010:1138) stated that “ERP is a different class of IS”. According to Ifinedo et al. (2010), the first reason is related to the implementation of ERP systems that requires business process engineering because such processes are intended to completely change the adopting company. For instance, the system users in the company need to be trained to use the new system, as well as to follow new processes and procedures (Holsapple et al., 2005). ERP was described by Ifinedo et al. (2010) as “deterministic technology” that requires the company’s work processes to be integrated with other software application modules (Klaus et al., 2000).

The second reason for adopting an ERP system is related to the complexity of implementing ERP systems in comparison with traditional information systems. In fact, companies that adopt ERP systems find it difficult to establish such endeavours without identifying the benefits that they may gain and having external resources and expertise when implementing these complex technologies (Wang et al., 2008). As a result, “success measurement models used for other typical IS success evaluations may not be adequate for ERP systems” (Ifinedo et al., 2010:1138).

Additionally, the majority of the research studies using the DeLone and McLean (1992) IS success model focus on people rather than systems (Fan and Fang, 2006). However, low usage of information systems could cause low return of IS investment (Sichel, 1997). Thus, the usage intention of the system users can be considered an important determinant to information system success (Fan and Fang, 2006). Further, this model suggests that information and system qualities are important factors for the success of information systems, since the ERP system is within the framework of information systems. Thus, PEOU and PU are functions of the information system quality.

Different research studies (such as Pan and Jang, 2008; Kouki et al., 2010; Ramdani et al., 2009) examined the adoption of ERP systems by the use of a TOE framework. However, some studies based on this framework have several limitations (Gangwar et al., 2014). For example, Low et al. (2011) indicated that TOE framework's lack major constructs and that variables of TOE frameworks may differ from one context to another (Wang et al., 2010). Thus, TOE frameworks should include other variables – such as sociological and cognitive variables – to enrich them (Jang, 2010; Wen and Chen, 2010).

Musawa and Wahab (2012) investigated the adoption of Electronic Data Interchange (EDI) in Nigerian SMEs and extended to the TOE framework. The authors concluded that the TOE framework lacks the explanatory power of IS adoption, where nearly half of the EDI variance remains unclear. Dedrick and West (2003) argued that the TOE framework is only concerned with variables classifications and the framework cannot be considered as a well-developed theory because it does not act as an integrated conceptual framework.

The TOE framework has been integrated with other technology acceptance frameworks that have clear constructs and, more particularly, with TAM. However, integrating TOE and TAM raises concerns relating to the variables of the two models. First, TAM has many external variables that have been identified and examined by different research studies, whereas TOE's variables differ from one research study to another and are not widely accepted (Gangwar and Raoot, 2014). Second, the significance of the variables for both frameworks differs from one country to another and from one technology to another. Some variables could be found to be consistently insignificant in a group of contexts or studies (Gangwar and Raoot, 2014).

Many researchers in the field of IT have tried to explain the utilisation and the adoption of technology. However, most of the existing models, theories and frameworks have failed to completely explain the reasons why a certain technology is unacceptable or acceptable by its users (Al-Jabri and Roztock, 2015). Moreover, according to Brown et al. (2002), voluntary adoption of technology was presumed by many researchers where the rejection of new technology was optional. However, in the real sense, there are instances when a



specific IT is mandated, making it difficult for users to reject. ERP system implementation is an example of mandated IT (Al-Jabri and Al-Hadab, 2008).

A significant variation exists with regard to IT acceptance; in some instances, major users are not consulted when investing in IT (for instance, ERPs). According to Nah et al. (2004), the variation that characterises technology acceptance within mandatory contexts has not been explained by Davis' (1989) TAM model or Venkatesh and Davis' (2000) expanded TAM model. A vast amount of technological investments are conducted in involuntary environments (Al-Jabri and Roztocki, 2015). Morris and Venkatesh (2010) suggest that approximately 80% of Fortune 500 firms have adopted ERP. According to Momoh et al. (2010), ERP systems are very complex systems and such complexity may negatively affect an individual's PEOU, as well as PU. Thus, developing a conceptual model to guide HEIs in ERP adoption is very important for researchers as well as managers, in order to help them overcome the complex nature of ERP systems.

The next section (Section 3.3) discusses the empirical studies that have generally drawn on TAM, specifically in the ERP context.

### **3.3 USE OF TAM IN ERP ADOPTION**

TAM is regarded as being among the renowned models allied to technology acceptance and engagement, since it has portrayed immense potential in elaborating and envisaging information technology's user behaviour (Surendran, 2012; Tome et al., 2014). Compared with other technology acceptance models, TAM has been highly recommended by different researchers (Venkatesh and Davis, 2000; Ma and Liu, 2004) to be highly powerful and predictive. However, a review of prior ERP studies regarding TAM indicates that few studies have investigated ERP user acceptance and usage, and only a small number of articles have been published. According to a study conducted by Esteves and Bohorquez (2007), only 25 out of 640 publications were dedicated to ERP adoption. This was also supported by Zabukovsek and Bobek (2013), who examined TAM applications in ERP systems.

A number of research studies with positive results have been conducted on ERP systems with the use of TAM. For example, Lee et al. (2010) examined factor organisational support (formal and informal) on original TAM factors. Their study revealed that organisational support influences ERP's PEOU and PU. Calisir et al. (2009) examined the influence of different factors (subjective norms, compatibility, gender, experience and educational level) on behavioural intention to use an ERP system in a manufacturing firm. The outcome of their study revealed that subjective norms, PU and educational level are determinants of behavioural intention. PU affects attitude towards use and both PEOU and compatibility affects PU.

Hsieh and Wang (2007) researched the impact of PU and PEOU on extended use in one of the manufacturing organisations. The findings of their study confirmed that PU and PEOU influence intention to use, and that user satisfaction has no direct influence on the PU or PEOU of an ERP system. In a similar vein, Shih and Huang (2009) attempted to explain behavioural intention and actual use through incorporated additional behavioural constructs: top management support, computer self-efficacy and computer anxiety. Amoako-Gyampah (2007) embarked on a study aimed at finding out how the behavioural intention of using ERP systems was influenced by PU and PEOU. The findings of that study confirmed that PU, PEOU and users' level of intrinsic involvement were strong determinants of the intention to use technology.

In Blackwell and Charles' (2006) study, willingness to change as well as behavioural intention to adopt ERP systems was investigated in students. The findings of the study implied that willingness to change is affected by gender and perceived ERP benefits, while willingness to change greatly influences students' attitude. The study also confirmed that attitude of intention to use an ERP system is affected by the users' computer self-efficacy. Calisir and Calisir (2004) investigated the factors that have an impact on the satisfaction of end-users when operating ERP systems. They found that ERP end-user satisfaction is determined by both PU and learnability.

The application of one of TAM's extensions in an ERP environment was examined by Amoako-Gyampah and Salam (2004). The results of this investigation implied that project communication and training have an effect on shared beliefs, while shared beliefs have an effect on the PU and PEOU of the IT systems. Others – like Sternad et al. (2013) – examined the influence of different external factors (e.g., organisational, technological, individual and information literacy) on the post-implementation stage of ERP usage. The outcome of their study indicated that the external factors that are related to the “second-order factors” affected both ease of use and usefulness. Moreover, their study revealed that attitude is significantly influenced by ERP system users.

Bradley and Lee (2007) examined the relationship between training satisfaction and PU, PEOU and perceived effectiveness and efficiency on the adoption of ERP systems in one university. Their findings indicated that training satisfaction has an influence on ERPs' ease of use, and that both training and user participation influenced perceived effectiveness and the efficiency of the ERP systems. However, the sample of this research study was based on 143 participants from a mid-sized institution and, thus, the results of this research might not be generalisable for other institutions operating in the developed countries, such as Saudi Arabia. Furthermore, this study only used a small number of external factors to investigate ERP user acceptance.

Several research studies have been dedicated to examining the adoption of ERP in the context of Saudi Arabia. For example, Al-Jabri and Al-Hadab (2008) examined the effect of expected value, expected capability, ease of use and usefulness on individual's attitudes towards ERP. The results of their research indicated that both expected value and PEOU have a positive influence on a user's ERP acceptance. A more recent research study by Al-Jabri and Roztocki (2015) employed TAM and TRA models in a bid to extend prior research on ERP adoption by adding perceived information transparency as an external factor to the model. Their study aimed to examine both indirect and direct influences of such external factors on the adoption of ERP systems. The outcomes of their research indicated that perceived information transparency is directly influenced by PEOU as well

as PU, while both attitude and adoption are indirectly affected by the perceived information transparency of the ERP system.

Table 3.1 below shows the different research studies collected by the researcher. It also illustrates the main aim(s), the main predictor and the results for each research study.

**Table 3.1: Empirical Research Studies Using TAM for ERP Adoption.**

<b>Author(s)</b>	<b>Research Aim(s)</b>	<b>Main Predictor</b>	<b>Results</b>
Al-Jabri and Roztocki (2015)	Examined the direct and indirect effects of perceived information transparency on ERP adoption.	Symbolic adoption	Perceived information transparency is directly influenced by PEOU as well as PU. Both attitude and adoption are indirectly affected by the perceived information transparency of the ERP system.
Al-Jabri and Al-Hadab (2008)	Examined the effect of expected value, expected capability, ease of use and usefulness on individual attitudes towards ERP.	Attitude	Both expected value and PEOU have a positive influence on user's ERP acceptance.
Sternad et al. (2013)	Examined second-order factors on the original TAM.	Attitude	The external factors are related to the "second-order factors".  Affected both ease of use and usefulness of ERP systems.
Amoako-Gyampah (2007)	Examined the influence of PU and PEOU on the behavioural intention of using ERP systems.	Behavioural intention	PU, PEOU and users' level of intrinsic involvement were strong determinants of the intention to use ERP.
Amoako-Gyampah and Salam (2004)	The application of one of TAM's extensions in an ERP environment.	Behavioural intention	Project communication and training have an effect on shared beliefs, while shared beliefs have an effect on the PU and PEOU of the IT systems.
Hsieh and Wang (2007)	The impact of PU and PEOU on extended use.	Behavioural intention	PU and PEOU influence intention to use. User satisfaction has no direct

			influence on either PU or PEOU of the ERP system.
Bradley and Lee (2007)	Examined the relationship between training satisfaction and PU, PEOU and perceived effectiveness and efficiency on the adoption of ERP systems in one university.	Actual use	Training satisfaction has an influence on ERP ease of use, and both training and user participation are influenced by perceived effectiveness and efficiency of the ERP systems.
Lee et al. (2010)	Examined organisational support (formal and informal) as a potential factor on original TAM factors.	Behavioural intention	Organisational support influences the PEOU and PU of ERPs.
Calisir et al. (2009)	“Factors (subjective norms, compatibility, gender, experience, and education level) that affect behavioral intention to use an ERP system based on potential ERP users at one manufacturing organization.”	Behavioural intention	Subjective norms, PU and educational level are determinants of behavioural intention. PU affects attitude toward use, and both PEOU and compatibility affect PU.
Calisir and Calisir (2004)	Factors that have an impact on the satisfaction of end-users when operating ERP systems.	End-user satisfaction	End-user satisfaction with ERP is determined by both PU and learnability.
Blackwell and Charles (2006)	Examined students’ willingness to change and behavioural intention to adopt ERP systems by self-efficacy, perceived benefits of ERP and gender.	Behavioural intention	Willingness to change greatly influences attitude, and attitude is affected by the users’ computer self-efficacy.
Shih and Huang (2009)	Explained behavioural intention and actual use through incorporated additional behavioural constructs: top management support, computer self-efficacy and computer anxiety.	Behavioural intention and actual use	Top management support and computer self-efficacy influence both intention and actual use of ERP systems.

The above discussion shows that TAM has been used by different researchers to examine ERP adoption. Table 3.1 indicates that few studies have investigated ERP user acceptance and usage, and only a small number of articles have been published. Additionally, the majority of these studies focused only on the behavioural intentions or attitudes as the determining variables of ERP system usage. In fact, examining the actual system usage rather than only examining the usage intention – as well as a coinciding assessment of the framework, rather than dividing assessments of different parts of the framework – will boost the new proposed framework.

Despite the use of TAM and its variations have been investigated and developed in many IT environments. It is worth noting that there is a lack of research studies that have explained the acceptance of ERP systems in higher education using TAM, especially with regard to ERP usefulness and ERP ease of use. Moreover, the researcher is unable to locate a single research study that examines the adoption of ERP systems in HEIs using TAM in Saudi Arabia. This indicates that the application of TAM to ERP systems is relatively new and may add new insights into the factors underpinning the acceptance of ERP technology in HEIs. Thus, there is a necessity to examine ERP adoption in HEIs by the use of TAM in developing countries and, more specifically, in Saudi Arabia.

This research study will therefore fill the research gap acknowledged above by identifying the factors that may affect ERP adoption in HEIs. It will also develop a theoretical model for ERP adoption in HEIs located in Saudi Arabia. The next section (Section 3.4) aims to develop the research framework for ERP adoption in HEIs located in Saudi Arabia.

### **3.4 DEVELOPMENT OF A THEORETICAL FRAMEWORK FOR ERP ADOPTION IN HE IN SAUDI ARABIA**

Many empirical research studies (such as Adams et al., 1992; Segars and Grover, 1993; Davis and Venkatesh, 1996; Szajna, 1996) confirm the validity of TAM under various tasks, situations and technologies. Nonetheless, Davis et al. (1989) suggested that TAM should include other external factors (e.g., individual and organisational factors) when

evaluating the acceptance of a specific technology, because they may directly affect that technology's PU and PEOU. This may, in turn, indirectly influence technology acceptance behaviour (Szajna, 1996).

External factors act as the link between an individual's innate beliefs, attitudes and intentions and the numerous individual variations, circumstantial limitations and managerial controllable interventions that affect behaviour. However, according to Moon and Kim (2001), external factors are prone to variations depending on the technology, target users and context. Harrison and Rainer (1992) explain individual variations as the factors that are inherent to the particular user, such as their personality, demographic attributes, experience and training. Individual variations have increasingly gained attention in the TAM context (Venkatesh and Morris, 2000; Hong et al., 2001). TAM presents a framework through which the effects of external factors on the usage of a system can be investigated (Hong et al., 2001).

An extensive amount of research has been undertaken on the factors that affect the adoption of IT in different business sectors. Nonetheless, there is no general unanimity regarding the precise factors that may affect IT adoption. This has been supported by Chung et al. (2009), who suggested that while different studies seem to overlap with each other in terms of the factors that affect the adoption of ERP systems, there is no general consensus regarding the factors that are absolutely imperative to the success of all ERP projects. Each company has to reflect on the precise combination of success factors that best suits its particular organisational circumstances (Chung et al., 2009).

Technology adoption is not entirely dependent on the technical aspects of IT. External aspects – such as organisational and individual characteristics – are also important in order to facilitate adoption (Orlikowski, 1993). Implementation of ERP systems is complex and, therefore, their adoptions are prone to major problems that are related to organisational and individual issues, rather than to technical issues (Pan and Jang, 2008; Helo et al., 2008). Thus, ERP systems require individual perspectives coupled with organisational viewpoints. According to Gefen (2004), when organisations make their ERP systems both

useful and easy to use by their employees, this helps both organisational and individual strategic issues. Therefore, a good understanding of users' beliefs (e.g., PEOU and PU) is necessary.

Different research studies have used TAM and applied it to ERP systems by incorporating new factors in order to gain a better understanding of the determinants of technology acceptance and to increase TAM's predictive validity. For example, some research studies incorporate external factors – such as computer anxiety (Shih and Huang, 2009; Sternad et al., 2011), self-efficacy (Shih and Huang, 2009; Sternad et al., 2011), user training (Amoako-Gyampah and Salam, 2004; Bradley and Lee, 2007; Bueno and Salmeron, 2008) and top management support (Lee et al., 2010; Sternad et al., 2011) – to predict PEOU, PU and intention to use technology. Others incorporate factors from other frameworks of technology acceptance – such as subjective norm (Calisir et al., 2009) – to increase TAM's predictive validity. Finally, others incorporate the actual usage of technology (Bradley and Lee, 2007) to measure the technology usage.

Research studies that utilise TAM to understand ERP adoption have considered individual and organisational factors as independent factors that may affect the usage of ERP systems. Individual factors, as well as computer usage, are the main determinants of ease of use (Venkatesh, 2000). For example, Ling Keong et al. (2012) mentioned that in mandatory systems (e.g., ERP systems) subjective norm has a direct influence on usage intentions “over and above” PEOU as well as PU. Moreover, PU is impacted by social influence (e.g., subjective norm) processes (Venkatesh and Davis, 2000).

Other studies (such as Davis et al., 1989; Venkatesh, 2000; Venkatesh and Bala, 2008) have supported the influence of computer self-efficacy on PEOU. Previous research studies showed that computer anxiety facilitates the intention to use IT (Venkatesh, 2000; Phang et al., 2006). Gelbrich and Sattler (2014) stated that: “technology anxiety has a direct negative effect on intention to use, which is greater than the indirect effect through the reduction of ease of use”.



Organisational characteristics capture various social processes, mechanisms and support organisations that guide individuals and facilitate the use of an ERP system. Various studies have confirmed the significance of organisational factors on the attitudes of users, especially during the adoption of new ERP technologies. According to Igbaria and Chakrabarti (1990), support from top management improves the users' attitudes and reduces computer anxiety. Studies that have investigated the effectiveness and significance of training and education on the adoption of ERP systems are very few (Bradley and Lee, 2007). Managerial intervention, such as user training, affects ERP acceptance (Amoako-Gyampah and Salam, 2003) and, according to Bradley (2008), inadequate training decreases ease of use and increases users' resistance, which may have major consequences on ERP system success and usage.

In addition to the core determinants of TAM, this research will include other sets of factors (organisational and individual factors) that may affect the adoption of ERP systems in HEIs. Thus, this research will develop an extended version of TAM in order to investigate the factors that affect the adoption of ERP systems by HEIs located in Saudi Arabia.

A better understanding of the factors contributing to ERP users' acceptance of ERP systems is necessary to facilitate successful ERP usage (Nah et al., 2004). In the current research, the aims are to identify those factors leading users to improved use of their ERP system, to expand the basic TAM model with more generic contextual factors and to then examine their influence on the PU and PEOU of ERP. Studying the influence of external factors on constructs not only contributes to the theory development, but also helps in designing interventional programmes for organisations.

Based on the above discussion regarding ERP systems, two main categories of variables have been adopted in this research. The first category is organisational factors, such as top management support and user training. The second category is individual factors, such as subjective norm, computer self-efficacy and computer anxiety. These external factors (both organisational and individual) have been validated in different empirical studies, including research relating to ERP adoption, and have strong support in the literature.

However, despite the wide recognition of these factors in previous models, the majority – if not all – of prior research studies have failed to apply them in a single model in order to understand their influences on ERP adoption in the HE field. This research will also include external factors that are not presented in TAM; this may help in providing a better understanding with regards to ERP system usage in HEIs.

### **3.4.1 Organisational Factors**

#### **3.4.1.1 Top Management Support (TMS)**

The importance of support from top management in the success of ERP implementation has been underscored by a number of researchers (Seng, 2007; Dezdar and Sulaiman, 2009), especially when the results are dynamic and uncertain. According to Liang et al. (2007), top management should play the coercive leadership role to help employees get rid of any doubts about technology. They also asserted that the managers should pressure the organisation to acquire any resources needed for the project. Sternad and Bobek (2013:1517) defined ERP support as: “the degree to which an individual views adequate ERP support as the reason for his or her successful ERP usage”.

The benefits and significance of support from top management during the process of ERP implementation projects has been underscored in myriad studies (Bradford and Florin, 2003). Lee et al. (2010) assert that support from top management helps in improving emotional power and job satisfaction among employees, as well as the performance of the business. In addition, Leung et al. (2008) state that support from top management is a form of employees’ resource that helps in improving their productivity and alleviating/mitigating workplace stressors. Fishbein and Ajzen (1975) argue that support from top management helps organisations that rely on technical systems to encourage their employees to use the systems. According to Willcocks and Sykes (2000), the success of ERP projects is contingent on sponsorship and support from senior-level management.

The implementation of ERP projects goes beyond a simple changing of software systems because it also entails repositioning the organisation and transforming every business practice. For this reason, it is imperative that top management openly, explicitly and

earnestly support (in both financial and non-financial means) the whole process of ERP implementation. If employees are endowed with sufficient support during this process, their productivity and satisfaction in the workplace is likely to greatly improve. In addition, when the organisation provides support to the employees in the form of training, the employees are less likely to develop the workplace stress that can result from operating such systems.

There has been an immense application of management support in computing environments. In a study conducted by DeLone (1988), the involvement of senior management in the process of computerisation was found to improve the success of using computers in small manufacturing firms. According to Henry and Stone (1995), support from top management enables the organisation to persuade and encourage the behaviour of the employees. Henry and Stone (1995) adopted a structural equation model to investigate the impact of management support on the implementation of a computer-based order entry system in a large non-profit hospital. They found that management support has an indirect effect on the performance of the users, because it improved their computer self-efficacy as well as their outcome expectancy. In addition, management support also facilitates the appropriate allocation of resources when a new innovation is being adopted.

There are several studies that have tried to investigate the impact of support from top management with regard to a specific technology or IT system. According to Premkumar and Potter (1995), the success of adopting some of the expensive technology applications (e.g., ERP systems) is highly contingent on support from top management. In other studies, top management support (TMS) has also been shown to improve the success of end-user computing models (Rivard and Huff, 1988) and the Decision Support System (DSS; Rockart and Flannery, 1983). Premkumar and Ramamurthy (1995) even established that support from top management was vital for the success of electronic data interchange (EDI). It was also noted that support from top management was a significant determinant of users' attitudes towards MIS (Zmud, 1979) and reduces computer anxiety (Igbaria and Chakrabarti, 1990). Igbaria et al. (1995) also confirmed the importance of

TMS when they investigated the effect of management support, organisational computing support and end-user computing (EUC) support on the PU and PEOU of microcomputers.

Sabherwal et al. (2004) mentioned that it was evident from research on information systems that TMS positively influences users' perceptions of information systems. System users who receive sufficient support from their managers or supervisors would have a better understanding regarding the relevance of the system that is related to PU (Bendoly et al., 2006). Urbach and Ahlemann (2010) concluded that TMS is critical in building up and determining users' perceptions on system usefulness. In fact, according to Nwankpa and Roumani (2014) and Rajan and Baral (2015), TMS is essential and shapes users' perceptions regarding the usefulness of the system. Moreover, Nwankpa and Roumani (2014) assert that TMS helps users to understand ERP usefulness.

TMS is also critical in forming users' perceptions on the system's ease of use. Lee et al. (2010:273) stated that: "when an organization provides sufficient support to their employees for using a system, the employees will more easily use and access the system". Additionally, Davis et al. (1989) asserted that TMS affects both the PU and the PEOU of a system. Costa et al. (2016) examined the main determinants of ERP satisfaction and adoption. The results of their study showed that TMS significantly and positively affects the PU and PEOU of ERP systems. This was also supported by Lee et al. (2010) who examined the influence of TMS on the behavioural intention of the users of ERP systems. The findings of their study indicated that TMS is positively associated with the PU and PEOU of ERP systems. This was also supported by Rajan and Baral (2015), Shih and Huang (2009) and Ngai et al. (2007), who concluded that TMS strongly and positively affects the PU and PEOU of ERP systems.

Given the above findings, this research suggests the following hypotheses:

- *Top management support (TMS) will have a direct and positive effect on the perceived ease of use of ERP systems.*

- *Top management support (TMS) will have a direct and positive effect on the perceived usefulness of ERP systems.*

#### **3.4.1.2 User Training (UT)**

Some of the key factors that influence the success of implementing an ERP system include user training (UT), education and user involvement. As documented in numerous studies, this can be attributed to the fact that they are expensive, time consuming and require precise management of human resources (Wu and Wang, 2006; Noudoostbeni et al., 2009; Tsai et al., 2010). UT or education is regarded as the third most important factor that has the potential to influence ERP implementation, particularly because it not only facilitates the adoption of new ERP systems to users but also facilitates the process of change in an organisation (Zornada and Velkavrh, 2005).

In order to realise the benefits of an ERP system, it is imperative to educate or train users and make sure they are well acquainted with the system throughout the whole process. Koh et al. (2009) analysed the studies that have been conducted on ERPs and business practices adopted by most ERP vendors and trainers. They found that an extensive training model, which uses external specialists as part of the training, is required for the successful implementation and roll out of ERP systems.

According to Kale (2000), one of the most significant factors that determine the success and failure of the implementation of ERP systems is the appropriateness and effectiveness of the training method used. This corresponds with the assertion of Koh et al. (2009) that, similar to other new technologies in an organisation, staff members that handle ERP systems require training to enable them to use the systems both accurately and effectively. A large number of previous studies on ERP systems point out that training is an indispensable factor in its successful implementation. Botta-Genoulaz and Millet (2006) established that the optimisation of ERP systems can be realised through training. Their conclusion was made after analysing the results of 217 survey questionnaires completed by carefully selected staff members of manufacturing firms. To increase the validity of their study, Botta-Genoulaz and Millet also administered 14 qualitative interviews, which

were also factored into their conclusion. The findings of their study substantiated the significance of training as an imperative factor required in the mastery of ERP software, which then leads to the realisation of the full potential of an ERP system.

Since the implementation of ERP generally calls for a colossal re-engineering of the organisation, the significance of training in ERP implementation should never be downplayed. According to Lassila and Brancheau's (1999) study, the initial user experience is imperative in the implementation of new software packages. When organisations change the course of their business through the adoption of new technology, it is imperative for them to prepare and help their employees in the transition process through comprehensive training. Training has been reported by employees as a significant factor that helps in getting used to new technologies, thereby reducing mistakes (Ferrando, 2001).

Buchner (1999) asserts that, regardless of the software chosen, the implementation of ERP helps organisations integrate their business applications and data libraries, thereby easing the transition to the new system for users, circumventing downtime because of training and decreasing the expenses of data migration. As documented by Stedman (1999), PeopleSoft (which is currently a division of Oracle) initiated a satellite-based system aimed at conveying live training to hundreds or even thousands of employees from organisations that purchase its ERP software, and in essence this underlines the significance of training.

Budgets for ERP implementation, according to Brown (2001), are supposed to take account of both training and the time needed for implementation. After conducting a study on the Gartner Group, Coetzer (2000) concluded that 25% of the ERP budget should be allocated to the training of users. Lassila and Brancheau (1999) also established that when most organisations are adopting commercial packages, they tend to cut training costs. This usually leads to negative attitudes regarding the systems, as well as low-integration equilibriums. Stein (1999) argued that since the implementation of ERP systems requires immense amounts of time and money, they have the potential to disrupt the culture of an

organisation, to generate intense training requirements and even to bring about dips in productivity as well as mishandled orders.

According to Grossman and Walsh (2004), training is one of the most important factors of software implementation and it should never be overlooked or downplayed, particularly because it enables the reduction of operational and cultural impediments of the implementation process.

The intensity and length of training recommended or prescribed by SME-specific ERP systems varies between different vendors and trainers. According to Koh et al. (2009), inadequate and restricted training often leads to negative effects on the success of SME-specific ERP systems. In a study conducted by Laukkanen et al. (2007), it was established that knowledge regarding ERP systems in SMEs is usually very low and, as a result, training of employees is important. Based on these assertions, Sun et al. (2005) conducted a pertinent study and established that the fundamental factors of success were related to people – i.e., staff and users (for example, training) – and that these should be given the highest priority when implementing ERP systems.

Insufficient and ineffective training usually leads to the weak implementation of ERP systems, which then results in failure. This is because the insufficient and ineffective training offered is not enough for the staff and managers to become fully acquainted with the manner in which ERP systems operate. According to Choi et al. (2007), inadequate training can also frustrate the enthusiasm of those users who might otherwise have been willing to work with the systems.

Conversely, Esteves et al. (2002) assert that when training is given proper attention and detail, employees' perception regarding the organisation's reliability in terms of assurance of job security improves, thereby bringing about an overall improvement in work efficiency. In addition, since users of ERP are likely not to have any programming or system analysis expertise, proper and effective training can create a positive attitude regarding the system among the employees. This broadens the users' acquaintance of the

system, as well as their skills in operating the system. Moreover, Choi et al. (2007) assert that training prepares the users to get acquainted with the system's trends.

Based on the technology acceptance model (TAM) by Davis (1989), user acceptance is fundamental for the successful implementation of new technologies. In view of the fact that ERP systems are potentially a disruptive technology transformation, it is imperative for organisations to carry out training in a bid to establish acceptance of the technology among their users. System users need to understand how information systems can help them to achieve their own work (Bingi et al., 1999). This fact was explained by different research studies (Youngberg et al., 2009; Rajan and Baral, 2015) that confirm the direct effects of training on the PU of ERP systems. User training may also affect usage through PU (Agarwal and Prasad, 1999). Since training provides users with information regarding the new system (e.g., ERP system), users may have the opportunity to compare the new system with the old one and to identify the value and the benefits of new system. Therefore, it is predicted that training allows the system's users to shape the PU of the new system and how it links to their work.

It could be the users' first experience of training when their organisations adopt ERP systems. Therefore, it is possible that training would enhance the users' computer self-efficacy that then influences their attitude toward ERP by changing the users' PEOU of the system. According to Bradley (2008), inadequate training for ERP users decreases ease of use and increases users' resistance, which may have major consequences on the ERP system's success and usage. According to Ruivo et al. (2014), when users have a good understanding of the system because they are endowed with an adequate training programme, such training improves users' perceptions with regard how easy it is to use the system.

Amoako-Gyampah and Salam (2004) conducted a study on the effects of training, communication and "belief construct" (defined as the shared convictions regarding the benefits of a technology) on the PU and the PEOU of an ERP system during its adoption and implementation in a large international conglomerate. The results suggested that both



the PU and PEOU of ERP systems were influenced by training and were indicative of the significance of training in the acceptance of new technologies. This was also supported by Lee et al. (2010), who concluded that UT has positive effects on the PU and PEOU of ERP systems. Another study was conducted by Rajan and Baral (2015) to examine the effects of external factors on ERP usage by the use of TAM. The findings of this study indicated that UT has a significant positive effect on the PU and PEOU of ERP systems. Costa et al. (2016) examined the main determinants of ERP satisfaction and adoption. The results of their study also showed that UT significantly and positively affects the PU and PEOU of ERP systems.

Given the above findings, this research study suggests the following hypotheses:

- *User training (UT) will have a direct and positive effect on the perceived ease of use of ERP systems.*
- *User training (UT) will have a direct and positive effect on the perceived usefulness of ERP systems.*

### **3.4.2 Individual Factors**

#### **3.4.2.1 Computer Self-efficacy (CSE)**

Self-efficacy has been a critical pillar in social learning theory (Bandura, 1986; Bandura and Wessels, 1997). Self-efficacy implies the belief in one's capacity to perform a given task or an individuals' belief in his own capacity to successfully undertake an activity (Bandura, 1986; Bandura, 1997). Additionally, perceived self-efficacy is the belief in an individual's capabilities in organising and executing a course of action that is necessary for a desired outcome. Perceived efficacy arises from accomplishing certain performance targets, verbal persuasion, exceptional experience and state of mind. Various studies have established that perceptions of self-efficacy may influence decisions on what behaviours to enact and persistence towards a certain behaviour, as well as an individual's actual performance accomplishments with regard to behaviour (Bandura, 1997; Locke et al.,

1984; Wood and Bandura, 1989). Compeau and Higgins (1995) established that self-efficacy played a significant role in determining whether one intended to use or apply information technology tools. Again, Hill et al. (1987) reported a significant relationship between CSE and behavioural intentions.

Self-efficacy could be an important factor when considering whether a new process should be adopted (O'Cass and Fenech, 2003). Venkatesh and Davis (1996) concluded that computer self-efficacy (CSE) determines perceptions of ease of use in practically all cases. Venkatesh and Davis (1994) and Venkatesh (2000) explored the effect of self-efficacy on PEOU in email and Gopher. Their studies revealed that perceptions regarding a new system's ease of use were dependent on an individual's CSE. This was also supported by Davis et al. (1989), who concluded that self-efficacy is an antecedent of PEOU, as well as the ability to use a particular technological tool. However, other studies show that the effects of CSE on PEOU are weak (Hung et al, 2003; Lopez and Manson, 1997). In contrast, other research studies confirm the effects of CSE on PEOU (Agarwal and Karahanna, 2000). Studies by Thong et al. (2002) and Shih (2006) concluded that CSE significantly influenced PEOU in TAM. Elkhani et al. (2014) examined the effects of CSE on ERP usage. The results of their study showed that CSE has positive effects on the PEOU of ERP. Furthermore, according Rajan and Baral (2015), CSE positively affects the PEOU of ERP systems. Additionally, they found that CSE is the main determinant of PEOU and this was also supported by Venkatesh and Davis (2000).

Generally, users who possess high levels of CSE are more likely to be competent in using various systems (Compeau and Higgins, 1995). Such high levels of CSE may allow users to explore various features of the systems and discover their usefulness. Agarwal and Karahanna (2000) assert that CSE plays a critical role in explaining technology usage through PU. Kwahk and Ahn (2010:187) stated that: "when individuals believe that they will be able to use computers and IT with great skill, they are more likely to expect beneficial outcomes from using computers and IT compared to when they doubt their computer related-capabilities". According to their study, CSE significantly and positively affects the PU of ERP systems. This finding was also supported by Hwang and Grant

(2011). Shih (2006) and Rajan and Baral (2015) concluded that CSE affects the PEOU and PU of ERP systems; therefore, it is worth examining the positive effects of CSE on the PEOU and PU of ERP systems.

Given the above findings, this research study suggests the following hypotheses:

- *Computer self-efficacy (CSE) will have a direct and positive effect on the perceived ease of use of ERP systems.*
- *Computer self-efficacy (CSE) will have a direct and positive effect on the perceived usefulness of ERP systems.*

#### **3.4.2.2 Computer Anxiety (CA)**

Research on the subject of computer anxiety (CA) is fundamental because it has been proven that CA leads to the avoidance of computers and also because CA is a phobic condition that can be altered (Olatoye, 2011). CA can be defined as the level of an individual's uneasiness, or even fear, when she or he encounters the likelihood of using computers (Venkatesh et al., 2003). Shu and Wang (2011) define CA as the inability of an individual to deal with the emerging and developing ICT usage trends both in the professional or social realms. According to Howard and Smith (1986), CA can make some people avoid using computers to complete tasks. In the workplace, computer phobia and anxiety among employees can result in detrimental outcomes such as sabotage, increased mistakes, low motivation, truancy, interpersonal conflicts and reduced quality of work (Igbaria and Chakraberti, 1990). Howard and Smith (1986) came up with a theory that summarised the causes or sources of CA: (1) deficiency in operational experience, (2) insufficient acquaintance of computers and (3) psychological makeup. They pointed out that deficiency in operational experience is the easiest cause to treat, followed by insufficient acquaintance of computers. Finally, psychological makeup is the hardest cause of CA to treat.

CA has been found to cause reduced use and even total avoidance of information technology. Brown and Vician (1997) asserted that avoidance of IT can have detrimental effects on students' scholastic advancement and business performance, and it can ultimately have adverse effects on an individual's career opportunities. According to Rosen and Weil (1995), approximately 40% of the US population experience some level of CA. Most of the individuals who experience CA actively resist using computers despite the accessibility of hardware and software and the association that positive results can stem from the use of computers. In a study conducted by Bozionelos (1996), 20% of the sampled British managers and professionals had computer anxieties that were beyond the mid-point on a CA scale. The growing use of personal computers in organisations, the education sector and at home means that CA has become a pertinent problem of the modern age.

It has not yet been confirmed whether the blossoming use of the internet and the growing use of technologies like digital telephony will reduce the prevalence of CA or augment it. Different methods and approaches have been used to study CA and a number of studies have revealed that CA might not be a single-dimensional construct. For example, according to Loyd and Gressard (1984), CA can be looked at from three separate perspectives that include: self-confidence when handling computers, apprehension of handling computers and liking of computers. In other studies, more emphasis has been placed on the various features of handling computers, such as whether anxiety was general or if it involved only particular aspects of computer use – e.g., manoeuvring through the keyboard or coping with system errors and/or crashes (Brosnan and Lee, 1998). In some studies, emphasis was placed on the conditions under which CA materialises, such as whether the anxiety only materialises when actually handling computers or whether it materialises only when an individual starts thinking of a situation involving the use of computers (Rosen and Weil, 1995; Dyck et al., 1998).

Necessary and Parish (1996) concluded that an increase in computer experience reduces CA. According to Hong and Koh (2002), people who have high levels of experience in

computer use usually have more positive attitudes regarding computer usage and lower CA. Glass and Knight (1988) concluded that the correlation between CA and experience is only observed during the users' first encounter with computers, after which the users become less anxious. Other studies (Buche et al., 2007; Heinssen et al., 1987) have revealed that CA can be predicted through an individual's self-efficacy, experience in computer usage and computer use. Compeau and Higgins (1995) asserted that individuals who have computer self-efficacy use computers more, thereby reducing their anxiety. According to Wilfong (2006), most of the individuals who had signs of CA gained self-efficacy after experience and interaction with computers.

Previous research studies showed that CA facilitates the intention to use IT (Phang et al., 2006; Venkatesh, 2000). Both intention to use and the PEOU of IT are affected by technology anxiety (Phang et al., 2006; Venkatesh and Bala, 2008). This was also supported by Brown and Town (2002), who assert that CA positively influenced PEOU. Venkatesh (2000) claimed that CA is an individual variable that affects users' perceptions of PEOU.

Gelbrich and Sattler (2014:8) stated, however, that "technology anxiety has a direct negative effect on intention to use, which is greater than the indirect effect through the reduction of ease of use". Moreover, Igbaria and Iivari (1995) also concluded that CA has a direct and negative effect on PU. ERP systems are a complex technology and such complexity may negatively influence users' PU and PEOU of these systems (Igbaria et al., 1995), especially users with high levels of CA. Shih and Huang (2009:267) stated that "individuals with lower anxiety are much more likely to interact with computers than people with higher anxiety".

Given the above findings, this research suggests the following hypotheses:

- *Computer anxiety (CA) will have a direct and negative effect on perceived ease of use of ERP systems.*

- *Computer anxiety (CA) will have a direct and negative effect on perceived usefulness of ERP systems.*

#### **3.4.2.3 Subjective Norm (SN)**

In Venkatesh's (1998) view, social influence is a function of subjective norms (SN) and social factors. SN may be described as "a person's perception that most people who are important to him/her think that he/she should or should not perform the behavior in question" (Fishbein and Ajzen, 1975:302). Taylor and Todd (1995) conducted a study where social influences were comparable to SN, representing other's opinions, peer influence and superior influence. According to Davis et al. (1989), in some cases individuals may apply a system in conforming to others' mandates rather than their own individual sentiments and beliefs. Adler (1996) also pointed out that social pressure could influence individuals' behaviour to varying degrees in different societies due to cultural differences. On the subject of computer acceptance, persons residing in a collectivist culture may adopt the use of computer technology due to pressure from seniors and peers.

It has been established that SN has two separate and varied roles, as follows. First, SN is the antecedent of behavioural intention and also serves as the antecedent of PU. Furthermore, empirical support for the link between behaviour and social norms may be found in numerous studies (Venkatesh and Davis, 2000; Huang and Palvia, 2001). Individuals may opt for a specific behaviour even when they do not regard it, or even its consequences, positively. The choice depends on the importance attached to the "important" referents' sentiments that they ought to act in a particular manner (Fishbein and Ajzen, 1975; Venkatesh and Davis, 2000). Additionally, Schepers and Wetzels (2007) and Chung et al. (2009) argued that SN could have a positive and considerable effect on intention to use in mandatory situations.

The second role of SN is that it has also been established to be a great determinant of behavioural intention in the context of a wide range of social behaviours (Fishbein and Ajzen, 1975). For instance, SN has been empirically demonstrated to have a significant

direct (Ajzen, 1985; Mathieson, 1991; Taylor and Todd, 1995; Park et al., 2007) and indirect (Venkatesh and Davis, 2000; Park et al., 2007) influence in determining whether an individual intends to use computer technology. Nevertheless, SN may not be consistent in predicting intention to use computers, with some studies revealing that such relationships are not significant at all (Davis, 1986). Indeed, early TAM researchers abandoned SN as a study subject on the realisation that there were no significant results as far as intentions were concerned. Recently, however, Lee (2006) and Lu et al. (2009) established that the effects of SN have a considerable influence on PU.

While TAM is critical in determining the factors influencing technology reception and application, it does not have the capacity to reveal the impact of the communication patterns of users. Indeed, the TRA – which represents TAM’s referent theory – integrates a social construct through SN. Therefore, a major advantage for TRA is the integration of SN and the review of their influences in certain circumstances (Glassberg, 2000). Moreover, SN is a feature that leads to significant results related to intentions in TPB, TRA and DTPB (Fishbein and Ajzen, 1975; Ajzen, 1985; Taylor and Todd, 1995; Lee et al., 2010).

In the present study, SN represents users’ perceptions of suggestions or opinions of major referents based on their acceptance of ERP systems. A user’s decision regarding the use of an ERP system might be impacted by the views of a significant referent. Moreover, this opinion does not have to be an explicit statement or even an order from a senior colleague or a friend. Measurements evaluated how users subjectively assessed the views of important referents in the course of their decision making.

SN has been deemed a major determinant in several models (such as TPB, TRA and DTPB). In the TAM2 model, SN has received empirical support and is viewed as a core concept (Venkatesh et al., 2003). Other studies have also confirmed SN to determine PU to the greatest extent, particularly when the user holds limited experience with the technology in question (Venkatesh and Davis, 2000). When peers or managers mention that using the system will be very useful, this could influence the perceptions of the users.

Thus, SN could be considered as a determinant for both PU and intention to use. Chung et al. (2009) conducted a study to examine the factors that affect ERP adoption in the construction industry. The results of their study confirm that SN has significant and positive effects on the PU of ERP systems. Additionally, Schepers and Wetzels (2007) confirmed that there is a strong and positive relation between SN and PU and intention to use. This was also supported by Kwak et al. (2012), who confirmed that SN has a positive and direct effect on the PU and intention to use ERP systems. For this reason, the researcher expects that SN may have a significant and positive effect on the PU and intention to use ERP systems.

Given the above findings, this research suggests the following hypotheses:

- *Subjective norm (SN) will have a positive and direct effect on perceived usefulness of ERP systems.*
- *Subjective norm (SN) will have a positive and direct effect on intention to use ERP systems.*

### **3.4.3 The Constructs of TAM**

The TAM model hypothesises that two specific beliefs are of the utmost significance in the determination of computer acceptance behaviours – perceived usefulness (PU) and perceived ease of use (PEOU). In other words, Davis et al. (1989) assumed that potential users of IT are more likely to adopt the technology if it is perceived as useful and easy to use. In TAM, individuals' attitudes are important in the determination of their behavioural intention, and individuals' behavioural intention of adopting a system is determined by their belief that the system will be important in improving their performance in the workplace. Moreover, individuals' attitude in TAM is mutually contingent on both PU and PEOU.



The relationships between the TAM constructs have been replicated in the research that forms this thesis. In other words, PEOU has a positive effect on PU and attitude towards the adoption of technology, while PU has a positive effect on attitude and intention to use the technology. The intention to use is positively influenced by attitude, while the actual use is positively influenced by the intention to use. A vast amount of research on technology acceptance in general (Davis, 1989; Davis et al., 1989; Venkatesh and Davis, 2000) – as well as in ERP studies (Amoako-Gyampah and Salam, 2004; Hsieh and Wang, 2007; Bueno and Salmeron, 2008; Al-Jabri and Al-Hadab, 2008; Calisir et al., 2009; Lee et al., 2010; Al-Jabri and Roztock, 2015) – confirms the relationships between the constructs of TAM.

#### **3.4.3.1 The Perceived Ease of Use (PEU) of ERP**

Perceived ease of use (PEU) is defined as “the degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis, 1986:82). Different research studies on ERP adoption (such as Amoako-Gyampah and Salam, 2004; Calisir and Calisir, 2004; Hsieh and Wang, 2007; Al-Jabri and Al-Hadab, 2008; Bueno and Salmeron, 2008; Calisir et al., 2009; Al-Jabri and Roztock, 2015) indicate that PEU has a significant impact with a direct effect on the PU of ERP. Additionally, according Al-Jabri and Roztock (2015), PEU has a significant impact with a direct effect on attitude toward ERP systems.

Given the findings above, this research suggests the following hypotheses:

- *Perceived ease of use (PEU) will have a positive and direct effect on the perceived usefulness of ERP systems.*
- *Perceived ease of use (PEU) will have a positive and direct effect on attitude towards ERP systems.*

#### **3.4.3.2 The Perceived Usefulness (PU) of ERP**

According to Davis (1986:82), perceived usefulness (PU) is “the degree to which an individual believes that using a particular system would enhance his or her job performance”. Various research studies (such as Calisir et al., 2009; Al-Jabri and Roztock, 2015) concluded that the PU of ERP has a positive influence with a direct effect on attitude. The PU of ERP also has a positive influence with a direct effect on intention to use ERP systems (Shih, 2006). Moreover, according to Ramayah and Lo (2007), PU has the most significant effects on intention to use ERP systems.

Given the findings above, this research suggests the following hypotheses:

- *Perceived usefulness (PU) will have a positive and direct effect on attitude towards ERP systems.*
- *Perceived usefulness (PU) will have a positive and direct effect on intention to use ERP systems.*

#### **3.4.3.3 Attitude (A) Towards ERP**

Fishbein and Ajzen (1975:288) defined attitude as how “an individual’s degree of evaluation affects the target behaviour”. According to Brown and Town (2002), attitude towards ERP has no significant effects on the intention to use ERP. However, the findings of different research studies (Bagchi et al., 2003; Calisir et al., 2009) confirm that attitude toward ERP has a positive influence with a direct effect on the intention to use ERP systems.

Given the findings above, this research suggests the following hypothesis:

- *Attitude (A) will have a positive effect on intention to use ERP systems.*

#### **3.4.3.4 Intention to Use (IU) ERP**

Fishbein and Ajzen (1975:12) defined intention to use as “a person’s intentions to perform various behaviors”. In other words, an individual can take the decision whether or not to become a user of ERP systems. According to different research studies (such as Davis, 1989; Bagozzi et al., 1992; Venkatesh and Davis, 2000), intention to use demonstrates a positive influence on the actual use of the system. Moreover, according to the meta-analysis by Legris et al. (2003), the majority if not all of the research that has examined the relationship between behavioural intention and actual use (usage) has found a positive relation. Studies on ERP systems (e.g., Youngberg et al., 2009; Sternad and Bobek, 2013) also found a positive and strong relation between behavioural intention and actual use of ERP.

Given the findings above, this research therefore suggests the following hypothesis:

- *Intention to use (ITU) will have a positive effect on actual use of ERP systems.*

#### **3.4.3.5 Actual System Use (Usage)**

Davis (1986:25) defined actual system use as “an individual’s actual direct usage of the given system in the context of his or her job”. Actual system use was applied by Davis (1989) as the main predictor of user technology acceptance and was measured based on the frequency of system usage and the length of time in use.

### **3.5 DISCUSSION AND FRAMEWORK DEVELOPMENT**

This section aims to discuss the framework development in this study. To achieve the desired objectives, two steps were initiated. The first step aimed to identify the external factors that may affect the adoption of ERP systems by HEIs. The literature review in the general IT field – and in the ERP field, in particular – was employed to establish a theoretical framework for this study. Additionally, the literature review helped to identify the research gaps that formed a baseline in developing suitable research questions and hypotheses. The proposed model in the current study was building upon TAM proposed

by Davis (1989). The focus of the second step was directed to building the model of factors affecting the adoption of ERP systems by HEIs.

### **3.5.1 Research Gaps**

The reviewed literature gives sufficient background regarding the level of study in the context of users' acceptability within the technology acceptance field, and provides grounds to select the baseline replica used to verify the significant main factors affecting the adoption of ERP systems in HEIs. The literature in technology acceptance supports the TAM proposed by Davis (1989) to be a suitable and highly powerful framework for further research regarding the acceptance of ERP systems.

This research study identifies the following gaps:

- A review of previous ERP studies regarding TAM indicated that few studies have investigated ERP user acceptance and usage, and only a small number of articles have been published (Esteves and Bohorquez, 2007; Zabukovsek and Bobek, 2013). Furthermore, based on the findings from the literature review, there is a lack of research that has explained the acceptance of ERP systems in HEIs using TAM, especially with regard to the usefulness and ease of use of ERP.
- The implementation of ERP systems is complex; therefore, their adoptions are prone to major problems that are related to organisational and individual issues, rather than to technical issues (Pan and Jang, 2008; Helo et al., 2008). Thus, ERP systems require individuals' perspectives coupled with organisational viewpoints.
- Two main categories of factors have been adopted: individual factors (subjective norms, computer self-efficacy and computer anxiety) and organisational factors (top management support and user training). These factors have been validated in different empirical studies and have strong support in the literature. However, despite the wide recognition of these factors in previous models, the majority (if

not all) of previous research failed to apply them in a single model in order to understand their influences on ERP adoption in the higher education field.

Based on the literature review on ERP systems, as well as on the TAM model, the identified factors have been incorporated into a single model to examine their effects on ERP adoption in the context of HEIs.

### **3.5.2 Choosing a Framework (TAM)**

The technology acceptance model (TAM) was chosen as a framework to determine the factors and examine the relevancy and importance of the extended external factors for the following reasons:

1. TAM has empirical evidence in explaining technology acceptance (Hu et al., 1999).
2. The TAM model has received significant support from various empirical research studies (Mathieson, 1991; Venkatesh, 1998; Venkatesh and Davis, 2000; Taylor and Todd, 1995) when compared with other models such as the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Innovation Diffusion Theory (IDT).
3. TAM is one of the most widely used models for IT adoption (Gefen and Straub, 2000; Gefen, 2003; Stoel and Lee, 2003).
4. TAM has been used as a theoretical basis for many empirical studies and has accumulated a great deal of support (Venkatesh and Davis, 2000; Van Slyke et al., 2003).
5. Different empirical research studies (Segars and Grover, 1993; Adams et al., 1992; Chin and Todd, 1995; Szajna, 1996; Davis and Venkatesh, 1996) confirm the validity of TAM under various tasks, situations and technologies.

The TAM (Davis, 1989) posits the beliefs of perceived usefulness (PU) and perceived ease of use (PEOU) as the determinant factors for the intention to use IT, and they mediate the relationship between external factors and behavioural intention to use IT. The IT usage intentions, in turn, directly influence usages.

### **3.5.3 Identifying External Factors**

The third objective of this research study (see Chapter One) is to identify the factors affecting the adoption of ERP systems in the HEIs of Saudi Arabia and to develop a theoretical model for ERP adoption in the HEIs of Saudi Arabia. Thus, the reviewed literature facilitates sufficient background regarding the level of study in the context of users' acceptability within the technology acceptance field, and it facilitates the choice of the baseline replica that is engaged to verify the significant main factors affecting the adoption of ERP systems in HEIs. Additionally, the factors identified in this study have been validated in different empirical studies and have strong support in the literature.

In addition, the fourth objective of this research is to conduct an empirical study and examine the relevancy and importance of the extended external factors; due to that, these factors are added to the TAM model to build the proposed models (see Section 3.5.4). According to Mathieson (1991:173), "without external factors TAM provides very general information on users' opinions about a system, but does not yield specific information that can better guide system development". This research observed that line of logic and incorporated not merely the main TAM determinants, but also other sets of factors that may affect the successful adoption of ERP systems in HEIs. In addition, the proposed model will be evaluated and authenticated in the analysis stage.

Lastly, the TAM model comprises several constructs (factors) and these constructs are unnoticeable (latent) elements that cannot be measured directly but can be symbolised or measured by one or more components known as indicators. Within this phase, all of the indicators that could be applied to gauge constructs are identified and the previous

research studies with a similar background will be applied to identify the last of the list of indicators (see Section 3.5.6).

#### **3.5.4. Building the Proposed Model**

This research proposed a model based on TAM, which was proposed by Davis (1989). It was clear from reviewing the literature that there were two main categories (individual and organisational) of factors that had been studied and had been shown to be relevant to understanding technology acceptance. The research model inclusively linked five external factors (organisational and individual) to perceived ease of use, perceived usefulness and intention to use, which was assumed to subsequently effect the actual use of ERP systems in HEIs. All of the above mentioned factors will be included in the proposed model.

The results from the literature review indicate that the TAM model could be extended for this research. For instance, both the TAM model proposed by Davis (1989) and some early TAM researchers ignored the influence of subjective norm (SN) on technology acceptance. However, other research studies assert the influence of SN on technology acceptance (Venkatesh and Davis, 2000; Lee, 2006; Lu et al., 2009). Therefore, based upon a modification of the TAM model, the proposed model of this research, as well as the proposed relationships between variables, has been altered.

This study is not like the majority of the previous TAM studies that examine ERP adoption and simply employ a single construct – that is attitude or behavioural intention – to utilise a system. In a mandatory environment where the use of IT is compulsory, TAM should be reconsidered by addressing user behaviour, attitude and intention (Nah et al., 2004). Additionally, Davis (1986) and Venkatesh and Davis (2000) concluded that there is a strong and significant relationship between intention to use and usage behaviour. Thus, the initial model employs the actual usage as the main construct. The newly developed model in this research proposed external factors (e.g., organisational and individual) that are not presented in the TAM; this may help in providing a better understanding with regards to the usage of ERP systems. The proposed model of this research (see Figure 3.7

below) will be revised and examined using structural equation modelling (SEM) in Chapter Five.

### **3.5.5 Defining Variables**

This research incorporated ten latent (unconfirmed) elements. Every factor was discussed in this chapter; every factor is explained in this part.

#### **3.5.5.1 Individual Factors**

- **Computer Self-efficacy (CSE):** “Judgment of one’s capability to use has been done in the past, but rather with judgment of what can be done in the future” (Compeau and Higgins, 1995:192).
- **Computer Anxiety (CA):** Computer anxiety stands for the level of an individual’s uneasiness, or even fear, when she or he is encountered with the likelihood of employing computers (Venkatesh et al., 2003).
- **Subjective Norm (SN):** “Individual’s perception that most people who are important to him/her think s/he should or should not perform the behaviour in question” (Fishbein and Ajzen, 1975:302).

#### **3.5.5.2 Organisational Factors**

- **User Training (UT):** Described as the level to which a user believes that he or she has had sufficient official and casual preparation after ERP completion (Amonko-Gyampah and Salam, 2004; Bradley and Lee, 2007; Bueno and Salmeron, 2008).
- **Top Management Support (TMS):** Is the way a user perceives sufficient ERP support as the reason for his/her successful ERP usage (Lee et al, 2010).

#### **3.5.5.3 Technology Acceptance Model (TAM) Factors**

- **Intention to Use (IU):** “A person’s intentions to perform various behaviors” (Fishbein and Ajzen, 1975:12). In other words, an institution can take the decision whether or not to become a user of ERP systems.



- **Perceived Usefulness (PU):** “The degree to which an individual believes that using a particular system would enhance his or her job performance” (Davis, 1986:82).
- **Perceived Ease of Use (PEU):** “The degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis, 1986:82).
- **Attitude (A):** “An individual’s degree of evaluation affects the target behaviour” (Fishbein and Ajzen, 1975:288).
- **Actual System Use (Usage):** “An individual’s actual direct usage of the given system in the context of his or her job” (Davis, 1986:25).

### 3.5.6 The Development of Research Questions

The main purpose of this study was to examine and identify factors that may affect the adoption of ERP systems by HEIs. To achieve this, the purpose statement was broken down from broad questions to more specific questions for the researcher to answer (Creswell, 2005). According to Bradley (2001:574), in order to achieve good research questions, these questions should be “stated clearly, researchable, and involved some concept related to either theory or an applied context”. Therefore, the research questions – based on the proposed model – were applied as follows:

1. What are the major factors that affect the adoption of ERP systems by HEIs located in Saudi Arabia?
2. What are the relationships between the factors influencing the adoption of ERP systems in HEIs in Saudi Arabia, based on the TAM model?

### 3.5.7 Research Propositions

Based on the above general questions, three matching prepositions were converted:

*Proposition 1:* Organisational variables – such as user training and top management support – influence the perceived ease of use (PEU) and perceived usefulness (PU) of ERP.

*Proposition 2:* Individual variables – such as computer self-efficacy and computer anxiety – influence the perceived ease of use (PEU) and perceived usefulness (PU) of ERP. Subjective norms (SN) influence PU and intention to use.

*Proposition 3:* Both perceived ease of use (PEU) and perceived usefulness (PU) influence attitudes toward ERP and, subsequently, attitude influences intention to use ERP. Finally, behavioural intention influences the actual use of ERP.

Building upon these propositions, specific questions were utilised to construct the research questionnaire as follows:

*Research Question 1:* Does top management support (TMS) have a positive effect on the perceived ease of use (PEU) of ERP systems?

*Research Question 2:* Does user training (UT) have a positive effect on the perceived ease of use (PEU) of ERP systems?

*Research Question 3:* Does computer self-efficacy (CSE) have a positive effect on the perceived ease of use (PEU) of ERP systems?

*Research Question 4:* Does computer anxiety (CA) have a negative effect on the perceived ease of use (PEU) of ERP systems?

*Research Question 5:* Do subjective norms (SN) have a positive effect on the perceived usefulness (PU) of ERP systems?

*Research Question 6:* Does perceived ease of use (PEU) have a positive effect on the perceived usefulness (PU) of ERP systems?

*Research Question 7:* Does top management support (TMS) have a positive effect on the perceived usefulness (PU) of ERP systems?

*Research Question 8:* Does user training (UT) have a positive effect on the perceived usefulness (PU) of ERP systems?

*Research Question 9:* Does computer self-efficacy (CSE) have a positive effect on the perceived usefulness (PU) of ERP systems?

*Research Question 10:* Does computer anxiety (CA) have a negative effect on the perceived usefulness (PU) of ERP systems?

*Research Question 11:* Do subjective norms (SN) have a positive effect on the intention to use (IU) ERP systems?

*Research Question 12:* Does perceived ease of use (PEU) have a positive effect on the attitude (A) to use ERP systems?

*Research Question 13:* Does perceived usefulness (PU) have a positive effect on the attitude (A) to use ERP systems?

*Research Question 14:* Does perceived usefulness (PU) have a positive effect on the intention to use (IU) ERP systems?

*Research Question 15:* Does attitude (A) have a positive effect on the intention to use (IU) ERP systems?

*Research Question 16:* Does intention to use (IU) have a positive effect on the actual use (USAGE) of ERP systems?

### **3.5.8 Research Hypotheses**

The research questions listed above can be re-framed as testable hypotheses as follows:

H1: Top management support (TMS) will have a direct and positive effect on the perceived ease of use (PEU) of ERP systems.

H2: User training (UT) will have a direct and positive effect on the perceived ease of use of ERP systems.

H3: Computer self-efficacy (CSE) will have a direct and positive effect on the perceived ease of use (PEU) of ERP systems.

H4: Computer anxiety (CA) will have a direct and negative effect on the perceived ease of use (PEU) of ERP systems.

H5: Subjective norms (SN) will have a positive effect on the perceived usefulness (PU) of ERP systems.

H6: Perceived ease of use (PEU) will have a positive effect on the perceived usefulness (PU) of ERP systems.

H7: Top management support (TMS) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.

H8: User training (UT) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.

H9: Computer self-efficacy (CSE) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.

H10: Computer anxiety (CA) will have a direct and negative effect on the perceived usefulness (PU) of ERP systems.

H11: Subjective norms (SN) will have a positive effect on the intention to use (IU) ERP systems.

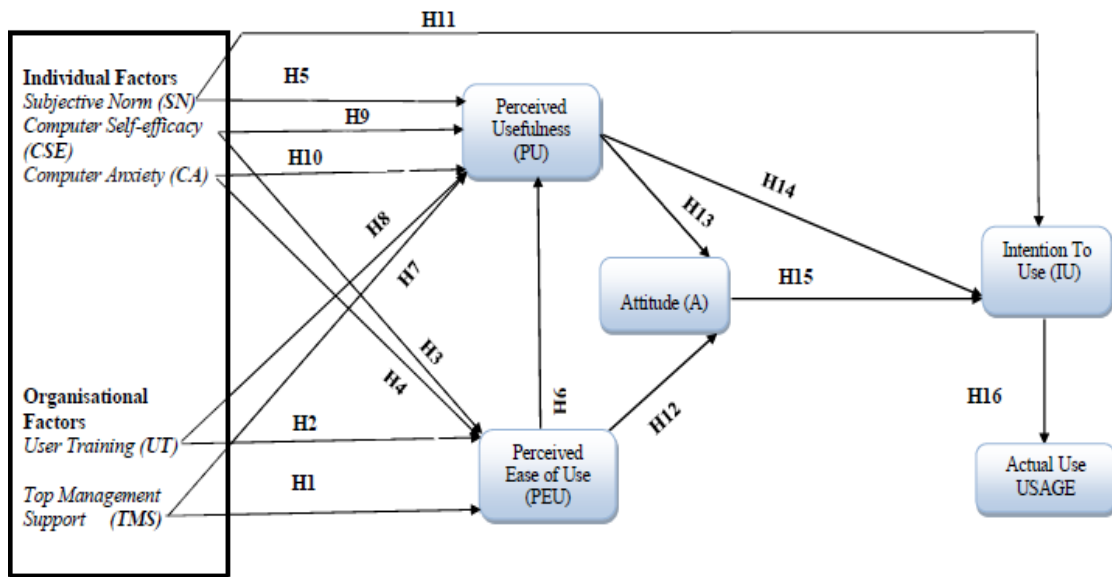
H12: Perceived ease of use (PEU) will have a positive effect on the attitude (A) to use ERP systems.

H13: Perceived usefulness (PU) will have a positive effect on the attitude (A) to use ERP systems.

H14: Perceived usefulness (PU) will have a positive effect on the intention to use (IU) ERP systems.

H15: Attitude (A) will have a positive effect on the intention to use (IU) ERP systems.

H16: Intention to use (IU) will have a positive effect on the actual use (USAGE) of ERP systems.



**Figure 3.7: Proposed Model for ERP Adoption in HEIs.**

### 3.6 SUMMARY

The main purpose of this chapter was to become more acquainted with the existing theories and models of technology acceptance among users and to identify existing evidence that may lend support to the proposed model structure. In addition, this chapter provides evidence to select the baseline model to be used in the determination of the significant factors that may affect the adoption of ERP systems in HEIs. Four well-known technology acceptance models were discussed and critiqued. Compared with other technology acceptance models, TAM has been highly recommended by different researchers to be extremely powerful and predictive (Venkatesh and Davis, 2000; Lu et al., 2009).

The literature review provides a background of how users' acceptance has been studied in the IT field in general and in the ERP field specifically. Despite the use of TAM, its variations have been investigated and developed in many IT environments. It is worth noting that there is a lack of research that explains the acceptance of ERP systems in HEIs using TAM, especially with regard to the usefulness and ease of use of ERP. Moreover,

the researcher is unable to locate one research study using TAM to examine the adoption of ERP systems in HEIs located in Saudi Arabia. Thus, there is a necessity to use TAM to examine ERP adoption in HEIs located in developing countries and, more specifically, Saudi Arabia.

It was clear from reviewing the literature that there were two main categories of variables that had been studied and shown to be relevant to understanding technology acceptance: individual factors (e.g., computer self-efficacy and computer anxiety) and organisational factors (e.g., top management support and user training). Research indicates that both categories have an influence upon technology acceptance. Based on the literature review on ERP systems, as well as on the TAM model, the identified factors have been incorporated in a single model to examine their effects on ERP adoption in HEIs.

The literature review also helped in identifying research gaps that form a baseline in developing suitable research questions and hypotheses. The proposed model in the current study was building upon the TAM model proposed by Davis (1989). This research study will, therefore, fill the gap by identifying the factors that may affect ERP adoption in HEIs and develop a theoretical model for ERP adoption in HEIs located in Saudi Arabia.

## **CHAPTER FOUR: RESEARCH METHODOLOGY**

### **4.1 INTRODUCTION**

This chapter describes the methodology approach employed in this study, involving quantitative data collection and analyses. The methodology starts with the description of the parameters used in the study. A research design acts as a formation or blueprint for carrying out the research. It specifies the procedures that are essential to acquire the necessary data to framework or plan the research that will look for possible resolutions to the study's question (Malhotra and Peterson, 2006).

The objective of this research study is to identify the factors affecting the adoption of ERP systems in the HEIs of Saudi Arabia. To accomplish this goal, the technology acceptance model (TAM) was evaluated in the previous chapter (Chapter Three) and will be applied as a theoretical framework. The methodology applied in this study will be discussed in depth within this chapter. Section 4.2 discusses the philosophy of the research as a first step. This study is accomplished within a largely positivist model, therefore it commences with a broad review of the related literature with the intent of identifying a theoretical framework of the pertinent factors affecting the adoption of ERP systems in HEIs.

Section 4.3 offers a comprehensive discussion of the research approach. A deductive method was employed in this research. When engaging this method, the researcher commences with a general hypothesis regarding the topic under scrutiny, then simplifies the topic down into further specific hypotheses that can be examined, before testing the hypotheses and finally justifying the hypotheses using the collected data. An explanation and comparison between methodologies (qualitative and quantitative) is available in Section 4.4. A quantitative method is applied to test objective theories by examining the relationships between variables.

The study's strategy is dealt with in Section 4.5. A survey will be employed as part of the quantitative method to collect data from individual employees. Using survey methods to



collect data allows the researcher to suggest possible reasons for particular relationships between variables and to produce a model of these relationships. A questionnaire will be employed as the data collection technique and is discussed in Section 4.6.1. Section 4.7 provides a comprehensive discussion of the generating items. This includes translating instruments, questionnaire presentation and scaling techniques. The sampling design and procedures are discussed in Section 4.8. Probability sampling was selected as the primary method for this research. Furthermore, the data collection plan is also discussed in this section.

Section 4.9 highlights the main statistical techniques that will be used in the analysis after collecting the required data. This includes confirmatory factor analysis (CFA), structural equation modelling (SEM) and analysis of variances (ANOVA). For validity and reliability, this research study will additionally utilise instruments that have been validated and applied by previous empirical research studies in similar areas. Furthermore, a pilot study will be conducted in order to clarify the research questions and resolve any unforeseen problems. Finally, a summary of the research methods used in this study is contained in Section 4.10. Figure 4.1 presents the conceptual road map of this chapter:



**Figure 4.1: Conceptual Road Map of Chapter Four.**

## **4.2 RESEARCH PHILOSOPHY**

The various theoretical viewpoints highlighted and condemned by past researchers facilitate current researchers to evaluate various research designs and methodologies at an earlier stage. In addition, such philosophical viewpoints provide new researchers with the basic knowledge to avoid incompatible applications and unnecessary work, plus realise the possible limitations of various study approaches. Within the society of researchers, a wide range of ontological and epistemological viewpoints can be drawn upon, each entailing significant disparities that may alter the thinking capacity of a researcher with respect to the process of research (Carson et al., 2001; as cited in Law, 2009). With reference to Kvale (1996), it is considered necessary to review any epistemological and ontological disparities since it could facilitate the reduction of any possible methodological hitches and maximise the outcome of the research examination procedure.

Methodological selection occurs from the researcher's personal epistemological and ontological perspectives and hence influences both the research strategy and the prospective output layout. According to Healey and Perry (2000), a certain range of researchers conduct their research within scaffolds identified as research paradigms. Referring to the previous definition offered by Deshpand et al. (1993:101), a paradigm is identified as "world-perception or affiliated assumptions regarding the world typically shared by a society of scientists assessing the globe". Another specification of paradigms, provided by Healy and Perry (2000), lists four prevailing paradigms of research: critical theory, positivism, realism and constructivism. Additionally, they also presented three components of paradigms: epistemology, ontology and methodology.

This study, however, provides a brief discussion of both epistemological and ontological approaches. Ontology is defined as the assumption that researchers and general scholars formulate regarding nature's reality (Easterby-Smith et al., 2002). This brings in questions regarding the suppositions specified by the researcher regarding the world, particularly in its operational perception. Ontology engages the depiction of the fundamental classes and relations of being, and concentrates on the formation and traits of reality wherein social

occurrences are explained – either subjectively comprehended as entailing existence through humans or objectively comprehended as not depending on humans (Saunders et al., 2007). Alternatively, Easterby-Smith et al. (2002) define epistemology as a universal set of theories regarding the excellent methods of analysing the nature of the world. Being a branch of philosophy, epistemology studies the components of acceptable knowledge according to the probable methods of obtaining knowledge and authenticating it.

To some level, the societal constructionist ontology – which is established by focusing on the combined reality constructed by the people, rather than objective and external factors – is allied with the inductive approach, whereby theory is followed by data, deriving findings from observations. Hence, it lends itself to qualitative approaches, as provided by Easterby-Smith et al. (2002). On the other hand, objective positive ontology is succeeded by deductive epistemology, whereby the justification or rejection of hypotheses is embraced objectively and data succeeds theory, lending itself to the quantitative criteria of research.

In the field of information system research, three research philosophies have been described: interpretive, critical and positivist (Orlikowski and Baroudi, 1991; Klein and Myers, 1999).

#### **4.2.1 Interpretive Philosophy**

The focus of interpretive research is on the intricacy of individual sense making in various situations, as well as in interpreting how individuals assign meanings to them (Kaplan and Maxwell, 2005). The main objective of interpretive research methods in information systems is on “understanding of the context of the information system and the process whereby the information system influences and is influenced by the context” (Walsham, 1993:5). The interpretive philosophy presumes that knowledge of reality is built upon multiple realities related to social context, such as tools, languages, shared meanings and consciousness. Such multiple realities rely on other systems for meanings that make it far more complicated to interpret in terms of constant realities (Lincoln and Guba, 1985).

According to Walsham (1995), studying reality cannot be examined without taking into consideration the involvement of various social variables, including the authors and the research subjects. Value-free data cannot be obtained by this philosophy because the author/researcher has pre-determined conceptions that direct the method of investigation and, for this reason, the parties involved in such research need to alter their perceptions. This is contrary to positivism where the research data collected by the author can be utilised to examine previous theories and hypotheses (Abbas, 2011).

Interpretive research seems to be contrary with the aims and objectives of this research study. This research aims to develop a model of factors affecting the adoption of ERP systems by examining previous theories, developing hypotheses and testing the relationships (cause and effects) between these factors rather than acquiring social knowledge to interpret and understand the meanings in human behaviour. This was also supported by other authors, such as Hudson and Ozanne (1988) and Neuman (2000), who indicated that the main aim of interpretive research is to interpret and understand the meanings of human behaviour, and that generalisation and prediction of cause and effects are not central to interpretive research. Additionally, the predefinition of both dependent and independent variables is neglected in interpretive research (Kaplan and Maxwell, 1994). Furthermore, and from the author's point view, there is no one way of understanding the situation – each author/researcher could have different assumptions with regards to reality.

#### **4.2.2 Critical Philosophy**

According to Avison and Pries (2005:244), critical research postulates “that social reality is historically constituted and that it is produced and reproduced by people”. Allowing people to build a better world for themselves is the fundamental aim of critical research (Cavana et al., 2001). People are willing to change their economics, as well as their social circumstances; however, constraints that may stem from cultural, social and political domination can limit their abilities to do so.

The main focus of the critical perspective is on the social critique. This type of research seeks to eliminate the roots of uncalled-for domination and alienation in order to boost and improve chances to understand human potential (Hirschheim and Klein, 1994). According to Abbas (2011:125), there are three main criticisms related to critical research:

Firstly, the level of actor agreement when rationalizing findings is perceived as fragile. Secondly, there is lack of evaluation due to absence of attention towards power and thirdly, the assumption of physical and social reality, interpretivists assume social order and are in control with interpretive methods.

According to Gummesson (2000), critical research cannot be effective, especially enterprise research that deals with the external world. This is because it does not take into consideration individuals' perceptions. Additionally, the critical paradigm might be inappropriate for business research because it does not give attention to the technological aspects of business (Hunt, 1991).

#### **4.2.3 Positivist Philosophy**

Positivism research is one of the oldest paradigms (Oates, 2006). Currently, the positivist philosophy is the most widely used paradigm in the research of information systems (Orlikowski and Baroudi, 1991). This paradigm postulates that observable occurrences can be examined and that reality can be assessed by looking at it through a one-way "value-free mirror". The research methodology under this philosophy is mainly quantitative and involves samples that represent a population.

According to positivists, reality is objective and therefore can be characterised by quantifiable properties. Positivist research is characterised by reductionism and repeatability (Neuman, 2000). The focus in the positivist approach, according to Gill and Johnson (2010), is on structured methodology to facilitate quantifiable observation that consequently leads to statistical analysis. The aim of the positivist is to examine theory in order to maximise the phenomena's understanding (Myers, 2010). In this philosophy, the

researcher proposes hypotheses and/or questions that are empirically tested within a controlled environment that ensures the research results are not affected (Guba and Lincoln, 1994).

Further explanation was provided by Collis and Hussey (2009), who indicated that positivist research focuses on establishing relationships between the variables by creating causal laws and connecting them to a deductive theory. They also stated that “social and natural worlds are both regarded as being bound by certain fixed laws in a sequence of cause and effect” (Collis and Hussey, 2009:56). This is also supported by Hudson and Ozanne (1988), who mention that human actions stem from real causes that influence their behaviour, and that the author and his research topics are independent and have no effect on each other. Positivists endeavour to remain separated from their research participants. They believe this is important because it helps the researcher to understand and differentiate between personal experience, reason and feeling (Carson et al., 2001).

A framework is a group or collection of interrelated variables, definitions and hypotheses that identify the relationships between the variables (Collis and Hussey, 2009). It was presumed that social phenomenon can be assessed, thus positivism is associated with “quantitative methods of analysis” (Collis and Hussey, 2009:56). Researchers who adopt this approach examine the influence of variable(s) on one another (Kaplan and Duchon, 1988). Therefore, examining individuals’ behaviour as well as numeric measures of development derives the domination for positivists (Creswell, 2009).

Abbas (2011:124) stated that “information systems research can be classified as positivist if there is evidence of formal proposition, variables (dependent and independent) that can be quantifiable, hypothesis testing, and the drawing of inferences about a phenomenon from the selected sample”. Since this research study is interested in developing a framework by identifying variables that can be quantifiable, a broad review of the related literature coupled with a self-administered questionnaire were carried out in order to identify the factors that may affect the adoption of ERP systems by HEIs. Users’ beliefs (such as perceptions and behaviour) of the system are important and could not be

undervalued. Thus, a positivist research approach was adopted in the current study because identifying the factors that may affect the adoption of ERP systems by HEIs was required in order to have a good understanding of users' beliefs of the systems and how such beliefs could influence the adoption of ERP systems. Sekaran (2003) confirmed that questionnaires of the self-administered type establish connection, inspire respondents and offer the possibility to clarify uncertainties of the current phenomenon.

After providing the reasons for choosing the positivist research approach in this section, research approaches will be discussed in Section 4.3 and a comparison section between quantitative and qualitative will be conducted in Section 4.4. In the following section (Section 4.3), justifications for utilising quantitative research and its relevance to this study will also be provided.

### **4.3 RESEARCH APPROACHES**

Typically, there are two extensive methods of research: deductive and inductive. According to previous literature, the inductive approach is derived from experiential observations moving to wide overviews and theories, equally known as the bottom-up approach (Sekaran, 2003; Trochim, 2006). While engaging this methodological approach, it is vital for a researcher to survey particular phenomena, detect regulations and patterns, plus derive some universal theories and conclusions based on their personal opinions. Conversely, a deductive method (also identified as a top-down approach), operates from universal theory to precise phenomenon (Sekaran, 2003; Trochim, 2006). When engaging this method, the researcher commences with a general hypothesis regarding the topic under scrutiny; the researcher then simplifies the topic down into further specific hypotheses that can be examined, gathers observations to tackle the stated hypotheses, tests the hypotheses and, finally, justifies the hypotheses using the collected data.

From researchers' perspectives, qualitative survey is mainly an inductive process (Jaber, 2012). Qualitative enquiry commences with scrutinising particular themes and topics, then reviewing any evolving patterns suggesting relations between variables and then eventually deriving and building theory. Conversely, Easterby-Smith et al. (2002)

suggested that in study society, a quantitative approach is likely to be linked with deductive processes and could be employed in examining theory and justifying generalisations regarding the phenomenon.

#### 4.4 COMPARISON BETWEEN QUANTITATIVE AND QUALITATIVE RESEARCH METHODS

There is no one universal methodology that is perfect for conducting research (Patton, 2002). The reliability of any research relies to a great degree on the design and method chosen by the researcher. Researchers may choose to use either quantitative or qualitative methodologies or a combination of both if they believe it to be more accurate in fulfilling and achieving their research objectives. However, each approach has its own advantages and disadvantages identified by different researchers and scholars (Kaplan and Duchon, 1988; Denzin and Lincoln, 2005; Creswell, 2009), as illustrated in Table 4.1 below.

**Table 4.1: Comparison between Quantitative and Qualitative Research Methods.**

<b>Qualitative Research Advantages</b>	<b>Qualitative Research Disadvantages</b>
Humanistic and holistic	Complex analysis and interpretation of data
Approach provides descriptions for both theories and experience	Unclear measuring
Value placed on participants' views and empowering participants	Maximises risk of bias
Not complex methods	Lack or limited generalisation
Exclusion of meaning and purpose	Non-scientific
Approach permits comprehensive understanding and insight	Samples usually small
Approach improves description and theory development	Not very helpful in the explanation of variance
Approach explores subjective dimensions	Rarely used in the information system field
Approach uses inductive data analysis	Requires more time
<b>Quantitative Research Advantages</b>	<b>Quantitative Research Disadvantages</b>
Permits accurate measurement of variables	Ignores some factors



Provides high possibility of generalisations	Subjective aspects of human existence are missed
Provides and covers wide range of situations	Inappropriate to some immeasurable phenomena
Applies statistical analysis	Deterministic character
Utilises structured and standard methods	
Dominant in IT/IS studies	
Requires less time and money	

Source: Adapted from Kaplan and Duchon (1988), Denzin and Lincoln (2005) and Creswell (2009).

#### **4.4.1 Quantitative Research**

The quantitative research approach focuses on numerical data in order to present concepts, levels of theoretical constructs and values that are considered to be strong scientific evidence. Both quantitative and positivist terms are frequently utilised in the same manner in relation to research. Creswell (2009:145) stated that quantitative methods are “means for testing objective theories by examining the relationship among variables, which, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures”. In addition, he also stated that in using such methods authors make “assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalise and replicate the findings” (Creswell, 2009:146).

Of the engaged approaches (quantitative and qualitative), the qualitative method seems to be linked with the phenomenologist model, while the quantitative approach seems to be associated with the positivist model that is relevant to the philosophy of this study. Based on the forms of data creation, a qualitative approach tends to accentuate words instead of quantification in the gathering and analysis of data. Thus, the qualitative approach has been described by Creswell (2009) as subjective and interpretive, and usually appropriate for new topics that have never been researched. ERP system adoption is not new topic and it has been previously addressed by various research studies.

The main aim of this research is to develop a model of factors affecting the adoption of ERP systems by HEIs. To achieve this, the research study attends to formulate hypotheses for subsequent verification; measure descriptive aspects of behavioural elements; decide reliability and validity and concentrate on a subject under analysis measured through objective methods rather than subjective inference. In addition, this research aims to empirically examine the proposed conceptual framework covering a wider sample population and to develop an appropriate survey. Therefore, a quantitative approach can be designed to provide broadness and generalisation to the findings. Qualitative approaches are often not generalisable, depending on the time and place, and might differ greatly based upon the author (Sekaran, 2003; Carson et al., 2001).

Moreover, the main assumption for quantitative research approaches is that individual behaviour can be elucidated by “social fact” that can be examined by methodologies that use “the deductive logic of the natural” (Amaratunga and Baldry, 2002). This method facilitates the division of phenomena into clear, controllable and well-defined variables. Quantification plays a critical role in breaking phenomena into specific and practical elements for a well-established conceptual framework (Abbas, 2011).

The main aim of qualitative research is to comprehend some part of individual experiences (Collis and Hussey, 2009); however, it utilises non-quantitative observations as well as non-statistical methods (Dooley, 2002). The explanation of variance provided by quantitative methods in statistical terms is more than in qualitative methods (Kaplan and Duchon, 1988). According to Kaplan and Duchon (1988), quantitative research methods have been tested and examined in information systems research studies, while qualitative methods have rarely been used in the information system field.

A quantitative method of research typically entails numerical data, which is quantified to answer the study questions, and usually exemplifies a questionnaire (Saunders et al., 2007). Finally, it is worth noting that earlier studies within the IT and ERP system contexts have employed quantitative approaches for data collection and analysis and for experimentally testing the proposed model (Amoako-Gyampah and Salam, 2004; Bradley

and Lee, 2007; Shih and Huang, 2009; Sternad et al., 2011). Thus, a quantitative approach is the appropriate approach because it suits the nature of this research study.

#### **4.5 RESEARCH STRATEGY**

Within the context of social science, there are many diverse research strategies that can be adopted by a researcher. A study by Remenyi et al. (1998) described research strategy as a method of accomplishing an individual's research, exemplifying a certain style and utilising diverse methods of research. From another perspective, research strategy identifies the approach engaged by the researcher in the endeavour of answering study questions systematically as opposed to arbitrarily. Zikmund (2003) identified research strategy as a criterion specifying the procedures and methods engaged in gathering and evaluating the required information.

Yin (2003) stipulated that the choice of research strategy should be selected as a function of the research situation. Generally, research strategy definition may amount to the various methods of gathering and analysing experiential data within the interest of the researcher and research in general. According to Saunders et al. (2007), there are three aspects that provide guidance to the preference of research strategy, namely:

1. The total time and monetary budget necessary for the research.
2. The form of research objectives and questions.
3. The theoretical foundations of the researcher.

Numerous forms of outstanding research strategies exist, such as experiment, case studies and survey (Sekaran, 2003). These strategies entail their individual definite approaches while gathering and analysing the collected data, and may provide different demerits and merits while accessing research information. Indeed, some of the above mentioned strategies are considered unsuitable for the objectives and aim of this study.

Experiments, which appear within positivist study methods, are typically engaged while studying natural sciences and characteristically engage a control group plus two or more

experimental groups. However, one setback associated with this approach is that the laboratory background is regularly dissimilar to the real world (Collis and Hussey, 2003).

According Alavi and Carlson (1992), case study is one of the most common approaches of qualitative research used in information systems. A case study approach is ideal for queries relating to “what”, “why” or “how” questions (Yin, 2003). Usually, the answers to these questions are not completely quantitative values.

In a comparison between survey methods and case studies by Yin (1994), the author argued that case studies are usually less rigorous and thus provide inadequate opportunity for generalisation. This was supported by Stake (1995), who criticised case studies due to their inability for generalisation. Dealing with large amounts of qualitative data is complex and requires support from analytic schemes (Yin, 1994). Moreover, the use of a qualitative approach as a data collection technique would be subjected to the interviewer and interviewee’s own understanding and will be difficult to replicate (Bryman, 2004).

The main disadvantage of a case study is primarily due to the researcher’s lack of events control and secondarily due to the fact that such questions cope with operational links requiring to be traced in due course, rather than focusing on current occurrence (frequency). In business research, case studies usually focus on an organisation or even part of an organisation; however, it might also be concerned with other aspects, such as events or groups of people. Some setbacks associated with this strategy (case study) incorporate intricacies in finding HEIs that are ready to participate in a research study, plus the need to contextualise procedures within a given period. According Saunders et al. (2007), case studies are costly and time consuming. Additionally, they are not suitable for developing a general conceptual framework (which is the main focus of this study) and therefore this method is not applied in this research.

Among the most prevalent and popular strategies is the utilisation of survey within the context of management and business studies. Survey equally facilitates the development of trends; for instance, verifying any possibility of specific organisations displaying norms

dissimilar from another firm of a different type. Generally, a survey approach is linked with a deductive design of research (Chen et al., 2000).

According Glassberg (2000), most if not all research studies using TAM have adopted the survey strategy. The survey method has been successfully utilised across a wide variety of domains in order to facilitate the development of measurement scales, to test hypotheses and to create theoretical models (Chen et al., 2000). The aim of this research is to identify factors leading users to better use of their ERP system and to expand the basic TAM model with more generic contextual factors and then examine their influence on the perceived usefulness, the perceived ease of use and the actual use of ERP systems. Therefore, the addition of new constructs (external factors) requires supplementary questions that follow previous work in the field. By using a survey method to collect data, this method allows the researcher to suggest possible reasons for particular relationships between variables and to produce a model of these relationships.

Furthermore, survey is one among the most familiar study strategies because it facilitates the gathering of a large quantity of information from a large population comparatively economically (Remenyi, 1998; Sim and Wright, 2000). Owing to the fact that this research aims at creating a model of factors affecting the adoption of ERP systems in HEIs, there is an urgency to have the model tested on a large sample. Thus, the survey strategy is preferred because it satisfies the nature of this study and its aims and objectives. In addition, the design of the survey method applied in this research is comparable to those employed in earlier TAM research and therefore upholds continuity.

#### **4.6 RESEARCH METHODS**

The main aim of the survey in the present study is to explore the usage of ERP systems by HEIs, and it is based on a survey of ERP users in HEIs who are believed to have relevant experience with, and insights into, the factors affecting their adoption of ERP systems. The greatest use of questionnaires is created in the survey strategy; therefore, the main data collection technique applied in this research is questionnaires.

#### **4.6.1 Questionnaire**

Questionnaire is a common word that encompasses the entire techniques of data collection, where every person is requested to reply to a similar set of queries in a pre-determined arrangement (Saunders et al., 2007). Pinsonneault and Kraemer (1993) describe the questionnaire as a way of collecting information from a large group of participants. Another description of the questionnaire was provided by Oates (2006), as a group of related research questions that are arranged in a systematic way.

Sekaran (2003:236) described a questionnaire as “a pre-formulated written set of questions to which respondents record their answers”. He declared that the questionnaire is an expedient data collection method and it is most frequently employed in a survey strategy. A questionnaire gathers data through posing a set of pre-formulated inquiries in a pre-determined succession and in a pre-arranged questionnaire to a model of persons drawn in order to represent a distinct population (Yin, 2009).

There are two kinds of questionnaires: interviewer-administered and self-administered. The questionnaires that are normally completed by participants are the ones known as self-administered questionnaires. Conversely, the interviewer records the replies to the interviewer-administered surveys on the basis of every respondent’s responses (Oates, 2006; Thomas, 2015). Examples of self-administered questionnaires include postal questionnaires, internet-mediated questionnaires and delivery and gathering questionnaires. On the other hand, structured interview telephone questionnaires are an example of a questionnaire of the interviewer-administered nature. Sekaran (2003) showed the relative benefits of self-administered questionnaires when compared to the other techniques of data collection in survey research. He claimed that questionnaires of the self-administered type establish connection, inspires respondents and offer the possibility to clarify uncertainties and boost the rate of response.

There are four different reasons for choosing the questionnaire in this study. Firstly, this study seeks to develop a conceptual model of the main factors affecting the adoption of ERP systems in HEIs through the use of secondary data (previous literature on ERP

systems) and primary data. The primary data will be collected from varied stakeholders (managers, supervisors and employees) working with ERP systems in HEIs in Saudi Arabia. Hence, it requires specific information from stakeholders in different HEIs, such as perceptions, attitudes and intentions to use ERP systems. This information is too complex to measure by observational techniques (McIntyre, 1999), but such information can be easily collected by the use of questionnaire (McIntyre, 1999).

Secondly, the questionnaire is not the only data collection technique that belongs in the survey strategy. Structural observation and structural interviews also often fall into this strategy. However, the questionnaire is one of the most widely used data collection techniques within the survey strategy and given that every participant is asked to reply to the same collection of questions, it offers an efficient means of gathering replies from a larger sample.

Thirdly, making generalisations through questionnaire is relatively easy and requires less time and investment (Bell, 1996). This is because a questionnaire consists of a large number of research questions that can be distributed to various respondents within a short time. Furthermore, collecting data via questionnaire and then analysing it can be easily accomplished by the use of different software packages, such as Statistical Package for the Social Science (SPSS) and Analysis of Moment Structures (AMOS; Bell, 1996).

Fourthly, it is worth noting that most of the research studies that have used TAM to identify the factors that may affect technology adoption employed questionnaires as the data-gathering technique and depended on the survey strategy to accomplish the research (Glassberg, 2000).

By using questionnaires within the survey, the researcher has to take into account the following limitations prior to using them:

- It is more difficult than researchers would think to produce a good questionnaire. Researchers have to make sure that they will gather the exact information that they

need to respond to the investigation questions and attain the necessary goals (Bell, 2005).

- The questionnaire provides simply one opportunity to gather the information, because it is frequently hard to recognise participants or to return to gather extra data (Saunders et al., 2007).
- It is possible that the questions could be misunderstood by the participants (Burns, 2000).
- The language of the questionnaire is one of the main significant factors in the design of the questionnaire. It is necessary to word queries in such a manner that they are easily interpreted by the participants (Sekaran, 2003).
- The questions drawn from other research have to be directed to ensure they will function as required with the type of respondents engaged. This is specifically essential in the research instruments that will be interpreted and supplied in different additional languages (Oppenheim, 1992).

Since the data collection will be carried out in Saudi Arabia, the questionnaire was translated into the local language (see Section 4.7.1). Following the preparation of the final version of the questionnaire, the questionnaire was conducted. The Arabic questionnaire was pilot-tested by means of Saudi Arabia HEIs.

A limitation that could be taken into account in the questionnaire is the actual usage factor. This factor will be measured through the “frequency of employing a system” and is characteristic of the convention metric regularly applied in MIS research (e.g., Ginzberg, 1981; Davis, 1986). Even though some existing research has used objective usage metrics from system logs, limitations (for example, the rules at Saudi Arabia senior learning institutions) of the study background did not authorise the collection of such information in this study, limiting the research to the examination of self-reported practice.



#### 4.7 GENERATING ITEMS

Depending on the descriptions of the variables, the instrument has been set up to supply the necessary information to test the proposed model. Given the existence of numerous published articles dealing with the variables in this study (encompassing those discussed previously in Chapter Three), a literature review within the TAM context will be employed to identify the last set of indicators (observed variables) for every latent variable within this research. Generating items from the literature has two benefits over the express elicitation of items (Davis, 1986). Initially, there is a rich set of published articles available to draw from, numerous of which have themselves used quantitative study methods to understand how subjects consider these constructs. Subsequently, these existing articles cut across a broad variety of objective systems, user populations and usage environments.

The descriptions of the latent variables, initiated in the earlier part in Chapter Three, will be employed as a guide for choosing which items from the literature to include in the first pools. Confirmatory factor analysis (CFA) will be applied to recognise the last group of items. Table 4.2 below identifies the articles applied for summarising the items (indicators) that are employed to measure every latent variable. These indicators will be adapted to the present context by specifying the desired target (using ERP systems).

**Table 4.2: Factors with Indicators of the Survey Instrument.**

Factor	Indicators	Previous Study(s)
	<b>TAM Factors</b>	
<b>Perceived Usefulness (PU)</b>	Using the ERP system would allow me to accomplish my tasks more quickly	Davis (1989)
	Using the ERP would improve my performance	
	Using the ERP would enhance my effectiveness in the work	
	Using the ERP would increase my productivity in the work	
	Using the ERP would make it easier to do my job	
	Overall, I find ERP useful in my work	
<b>Perceived Ease of Use (PEU)</b>	Learning to use the ERP is easy for me	Davis (1989); Venkatesh (2000)
	Learning to use the ERP is easy for me	
	I find it easy to get the ERP to do what I want it to do	
	My interaction with ERP is clear and understandable	

	Getting the information from ERP is easy	
	It is easy for me to become skilful at using ERP	
	Overall, I find ERP easy to use	
<b>Attitude (A)</b>	Using ERP is a good idea	Fishbein and Ajzen (1975); Davis (1989); Nah et al. (2004)
	I like the idea of using the ERP system to accomplish my tasks	
	ERP provides a good communication environment	
	I have a positive mindset towards the ERP system	
<b>Intention to Use (IU)</b>	I intend to use the ERP to do my work	Davis (1989); Venkatesh (2000); Venkatesh and Davis (2000)
	I intend to use the ERP in other jobs in the future	
	I intend to increase my use of the ERP in the future	
	Having used the ERP, I would recommend it to my colleagues to use it for work purposes	
<b>Organisational Factors</b>		
<b>User Training (UT)</b>	The training provided to me was complete	Amoako-Gyampah and Salam (2004); Bradley and Lee (2007)
	The training gave me confidence in the system	
	The trainers were knowledgeable and aided me in my understanding of the system	
	The training on the operation of the ERP was sufficient	
	Overall, my level of understanding was substantially improved after going through the training programme	
<b>Top Management Support (TMS)</b>	I felt that they supported the system	Lee et al. (2010)
	I felt that they had a high intention to change	
	The company promoted the system before implementation	
	Our top management supported the ERP implementation project well	
	The company provided training courses	
<b>Individual Factors</b>		
<b>Subjective Norm (SN)</b>	My peers believe in the benefits of the ERP	Ajzen (1991)
	My management team believes in the benefits of the ERP	
	Senior management strongly support my using the ERP system	
	I would like very much to use the ERP system because senior management thinks I should use it	
<b>Computer Anxiety (CA)</b>	Working with a computer makes me nervous	
	Computers make me feel uneasy	Venkatesh and Bala (2008); Shih and Huang (2009)
	Computers make me feel uncomfortable	
	Computers scare me	
<b>Computer Self-efficacy (CSE)</b>	I feel comfortable with ERP	Venkatesh and Davis (2000); Venkatesh and
	I am confident in using the ERP even if there is no one around to show me how to do it	

	I am confident in using the ERP even if I have never used such a system before	Bala (2008); Shih and Huang (2009)
	I am confident in using the ERP as long as someone shows me how to do it	
	I am confident in using the ERP as long as I have a lot of time to complete the job for which the software is provided	

#### **4.7.1 Translating Instrument**

Given that Arabic is the key language spoken in Saudi Arabia, the research will be carried out in the Arabic language. Therefore, the developed instrument will be translated from English into Arabic. As the majority of previous research in the field were conducted in English, such translation was more difficult than anticipated. Müller (2007:210) stated that “translation is not merely representation or reproduction; it creates something new and unique”. Translating from one language to another is not an easy task, mainly because authors could explain meanings differently (Temple and Young, 2004).

The questionnaire’s translation procedure is comprised of two stages. The initial stage is translating the questionnaire from English to Arabic by the means of two professional translators. The next stage is comparing the two editions and resolving all dissimilarity. Following the preparation of the last edition of the questionnaire, it will then be piloted.

#### **4.7.2 Scaling Technique**

Researchers have defined scaling techniques as allocating numbers to various classes of a question in the instruments (Sekaran, 2003). Such techniques can be utilised to help in classifying research respondents. The Likert scale is a measurement method that is mostly applied in survey questionnaires as a behaviour scale in conditions where no agreed standards exist. This scale is composed of both instructions and statements for respondents to declare their agreement or disagreement with each statement. According to Chin et al. (2008), the Likert scale has been heavily used in information systems research for over two decades.

A seven-point scale will be used in this study to calculate the TAM variables. This scale is recommended within the literature to suit the validity and reliability criteria (Davis, 1986; Davis, 1989; Venkatesh and Davis, 2000). These standard scales are readily adapted to the present context by specifying the desired target (using ERP systems). The previous literature (discussed in Chapter Three) was assessed for accessible scales satisfying the specified necessities (validity and reliability). Davis (1986) recommended that average scales (seven-point) be used since they are easy to employ, making them appropriate for the applied user recognition in testing the framework in which the model is planned to be employed, and they are normally able to achieve extreme levels of validity and reliability. Consistent with this research, the TAM variables will be evaluated by means of a Likert-type (agree–disagree) ranking format. The extent of agreement with the belief statements is measured using a seven-point “circle the number” rating scale.

One item will be applied to get a self-reported figure of the actual system use. A measure of the rate of use of the system will be applied to determine the actual use of the system. Frequency of using a system is characteristic of the usage metric regularly applied in MIS studies (e.g., Ginzberg, 1981; Davis, 1986).

#### **4.7.3 Questionnaire Presentation**

The questionnaire’s questions were developed based on the literature as well as the research framework. Closed-ended questions were employed in this study so that respondents could choose their answers from those provided in the questionnaire. Questions 1 to 7 are demographic questions, such as gender, experience, department, level of education, age, place of residence and marital status. Questions 8, 9 and 10 measure the actual use (USAGE) of ERP systems. Finally, Question 11 consisted of ten observed variables measured using a rating scale of 1 to 7, so that respondents can select their level of agreement or disagreement in each statement. A copy of the questionnaire can be found in Appendix A and B.

The questions on variables consist of 43 statements:

- Six statements measuring the user’s perceived usefulness (PU) of ERP systems.

- Six statements measuring the user's perceived ease of use (PEU) of ERP systems.
- Four statements measuring the dependent variable behaviour of intention to use ERP systems.
- Four statements measuring the user's attitude toward ERP systems.
- Five statements measuring the user's training on ERP systems.
- Four statements measuring the user's anxiety, which is related to user's uneasiness or even fear of using ERP systems.
- Four statements measuring the influence of other people and colleagues (subjective norm) on the ERP user.
- Five statements measuring the support the ERP user received from top management.
- Five statements measuring the user's self-efficacy, i.e., the user's ability and confidence in using ERP system.

#### **4.8 SAMPLING DESIGN AND PROCEDURES**

It could be possible for some research studies to survey the entire population and undertake census if the exploration focuses on a small potential population. However, surveying a large population could be costly, impossible and impractical. Consequently, it is prevalent for a researcher to consider a small portion of the population (referred to as a sample) that includes different members taken from the whole group of interest (Bajpai, 2010).

The majority of researchers need to use sampling procedures because the group of interest is often large, including various members or parts, making it impractical to collect data from the whole group. Therefore, sampling procedures provide different methods that assist researchers in the generalisation of their studies by establishing the representativeness of the whole population and then considering only a small potential sub-group (Sekaran, 2003).

This study uses a survey research strategy in order to answer the research question, as well as to achieve the research objectives. Specifically, it seeks to develop a conceptual model of the main factors that affect the adoption of ERP systems in HEIs through the analysis of primary data that will be collected from varied stakeholders working with ERP, including a variety of managers, supervisors and employees. In this research context, sampling consideration is needed because the group of interest is large.

#### **4.8.1 Sampling**

Early definition of the target population (who is to be surveyed) in the sampling process is important. Sekaran and Bougie (2009) defined the target population as the shared characteristics that should be estimated and measured accurately by the researcher. Inappropriate definition of the target population causes inaccurate results, which might jeopardise the success of the research. According to Churchill and Iacobucci (2005), both the scope of the study and the research questions play an important role in defining the target population and its precise requirements.

According to Saunders et al. (2007), there are two types of sampling: probability sampling and non-probability sampling. Non-probability sampling provides no statistical evidence or reasoning regarding the characteristics of the population. Additionally, the probability from the population to each case is unknown. A researcher needs to depend on his/her own judgment in order to answer research questions with no intent to develop generalisation through statistical techniques (Robson, 2002). Therefore, such sampling is usually associated with case study research (Churchill and Iacobucci, 2005). In comparison, in probability sampling all participants are known and have an equal opportunity of being included in the sample (Robson, 2002). This type of sampling is usually linked with survey research strategies (Churchill and Iacobucci, 2005).

Aaker et al. (2004) mentioned that probability sampling is more preferable than non-probability sampling because it gives the researcher better control over the research process and it can provide a group of participants whose characteristics may be taken to demonstrate those of the larger population. According to Babbi (2007), probability

sampling is the primary method for selecting large samples for social research. Thus, probability sampling is the preferable sampling method for this study.

Due to the complex nature of ERP systems, this study necessitates conducting empirical investigation with various ERP users working in HEIs. This study will be conducted with HEIs that have implemented ERP systems, but does not differentiate between mature and less mature adopters. This approach is required not only to improve the response rate, but also to provide opportunities to expand the range and diversity of approaches to ERP adoption. The existence of such an expanded range of approaches to ERP provides a comprehensive and holistic view of ERP and its adoption.

#### **4.8.2 Sample Size**

Collis and Hussey (2003) described quantitative research as substantial scale research based on large samples. Basically, choosing the sample size reflects the confidence of a researcher that the chosen sample will reflect the entire population and permit the accurate generalisation of the research findings. Larger sample sizes minimise any model fit bias (Garson, 2009). Additionally, the proper sample size is contingent on the observed variables (West et al., 1995; Baumgartner and Homburg, 1996), as well as on the proposed data analysis techniques (Malhotra, 2007). Structural Equation Modelling (SEM) will be used in this study, which is susceptible to sample size and negatively influenced when applied to small samples.

It is critical, however, to address that there is no unanimity regarding the minimum sample size. For instance, using a minimum sample size of 100 was suggested by Bollen (1998). Others advised that to achieve the purpose of the data analysis, the number of respondents in the research study should exceed 200 respondents with a set of variables (Bollen, 1989; Hair et al., 2010). Tabachnick and Fidell (2001) advised that a sample size of 300 cases (participants) is a good sample size. Furthermore, some researchers (e.g., Baumgartner and Homburg, 1996) advise a ratio with a minimum of 1:5 between the number of participants (cases) and the items to be factored.

Statistical methods can also be utilised when determining the appropriate sample size for a study. According to Saunders et al. (2007), the determination of sample size is usually dominated by the margin of error that a researcher can accept. The margin of error can be defined as the level of precision a researcher requires for any estimate made from a sample. If a confidence level of 95% is employed by researchers, it means that they will allow a 5% margin of error level. Table 4.3 below illustrates a confidence level of 95% for different sample sizes. Based on Table 4.3 – provided by Saunders et al. (2007:212) – a sample size of 384 is suitable for any population size.

According to Hair et al. (2006), in order to achieve generalisability in a research study, it is advisable that the sample size should be between 15 to 20 observations for each variable. This study consists of 10 variables and 43 items; therefore, a sample size of 394 responses that will be used for factor analysis can be considered sufficient. The items to sample size ratio for this study is 1:9.



**Table 4.3: Sample Size Variations.**

<b>Population Size</b>	<b>Degree of Accuracy/Margin of Error</b>			
	<b>0.05</b>	<b>0.035</b>	<b>0.025</b>	<b>0.01</b>
10	10	10	10	10
20	19	20	20	20
30	28	29	29	30
50	44	47	48	50
75	63	69	72	74
100	80	89	94	99
150	108	126	137	148
200	132	160	177	196
250	152	190	215	244
300	169	217	251	291
400	196	265	318	384
500	217	306	377	475
600	234	340	432	565
700	248	370	481	653
800	260	396	526	739
900	269	419	568	823
1,000	278	440	606	906
1,200	291	474	674	1067
1,500	306	515	759	1297
2,000	322	563	869	1655
2,500	333	597	952	1984
3,500	346	641	1068	2565
5,000	357	678	1176	3288
7,500	365	710	1275	4211
10,000	370	727	1332	4899
25,000	378	760	1448	6939
50,000	381	772	1491	8056
75,000	382	776	1506	8514
100,000	383	778	1513	8762
250,000	384	782	1527	9248
500,000	384	783	1532	9423
1,000,000	384	783	1534	9512

Source: Saunders et al. (2012:212).

### **4.8.3 Data Collection**

#### **4.8.3.1 Sample Characteristics**

Based on the theoretical framework, the study's questionnaire was developed, examined in pilot studies and then distributed to a sample of 600 ERP participants from different HEIs located in Saudi Arabia (see Table 4.4). Due to budget constraints, the researcher decided to conduct this study only on six HEIs located in different cities (Riyadh, Jeddah and Damam) in Saudi Arabia. Some of these intuitions also have different branches located in different areas in Saudi Arabia. These institutions are considered to be

representative of the wider population where different types of ERP systems have been adopted. The selected institutions were the largest universities in Saudi Arabia and have been using ERP systems on a daily basis to aid their academic and administrative sections. The employees of these HEIs were introduced to ERP systems over the last one to ten years, and these institutions believe that adopting ERP systems has significantly contributed to their success by creating competitive advantage and improving the efficiency of their operations. These institutions have all shown their interest and provided access in data collection.

The selected institutions have utilised ERP systems in similar departments (registration and administration, financial, human resource, IT, student affairs and marketing). Despite the similarities between these institutions, they also contribute to various sources of influence on employees, providing different understandings regarding the adoption and usage of ERP for work-related tasks. Such influences include the support from top management, user training, subjective norms and beliefs. This setting will help to identify perceptions and usage at various levels of individual's experience with the ERP system, because some of the institutions adopted the system a year ago while others did so ten years ago. Additionally, the collection of some data was in conjunction with training sessions related to ERP systems held at the different HEIs. This coincidence will aid the understanding of users' perceptions (e.g., PEOU and PU) and capture their perceptions regarding the system. Furthermore, many of the participants have more than five years of work experience in similar settings in HEIs, making this research study between them highly suitable.

To achieve the research objectives, there is a need to identify those participants who use ERP systems in their work on a routine basis. Therefore, six systems (registration and administration, financial, human resources, IT, student affairs and marketing) have been chosen by the researcher because these are the most used systems by different stakeholders within the chosen institutions. In comparison, other ERP systems (such as students and academic systems) were hardly used in some of the chosen institutions or not yet integrated. Therefore, the sample was limited to the employees and administrative

officials – as well as to different managerial levels, such as supervisors, managers and senior managers – who work within the six departments in the selected institutions.

A series of meetings and discussions were conducted by the researcher with key personnel (e.g., heads of resources and chief information officers) that were working for the selected institutions. Gaining access to collect data for this research study from the various institutions was difficult. To overcome this challenge, the researcher elucidated the significant contributions as well as the importance of the research to the selected institutions and offered to share the findings and the recommendations of the research study with them. The institutions then were convinced and interested to know about the benefits that may stem from the research findings to their institutions. An approval from the selected institutions was then granted to the researcher prior to conducting the research study. Table 4.4 below illustrates the chosen universities, the departments and the number of ERP users and their positions included in the study.

**Table 4.4: Details of the Sample.**

<b>University</b>	<b>Department</b>	<b>Participants</b>	<b>User Positions</b>
<b>A</b> (two branches)	Registration and Administration Departments	53	Two managers, two assistant managers, two supervisors and 47 employees.
	Financial Department	20	One manager, one assistant manager, two supervisors and 16 employees.
	Human Resource Department	26	Three managers, two assistant managers, two supervisors and 19 employees.
	Other departments (IT, student affairs and marketing)	18	Three managers, three assistant managers, three supervisors and nine employees.
<b>B</b> (one branch)	Registration and Administration Departments	29	Two managers, one assistant manager, one supervisor and 25 employees.

	Financial Department	14	One manager, one assistant manager, one supervisor and 11 employees.
	Human Resource Department	20	One manager, one assistant manager, two supervisors and 16 employees.
	Other departments (IT, student affairs and marketing)	15	Three managers, three assistant managers and nine employees.
<b>C</b> (one branch)	Registration and Administration Departments	27	Two managers, one assistant manager, two supervisors and 22 employees.
	Financial Department	16	One manager, one assistant manager and 14 employees.
	Human Resource Department	17	One manager, two supervisors and 14 employees.
	Other departments (IT, student affairs and marketing)	14	Three managers, one assistant manager and ten employees.
<b>D</b> (two branches)	Registration and Administration Departments	36	Two managers, two assistant managers, two supervisors and 30 employees.
	Financial Department	12	One manager, one assistant manager and ten employees.
	Human Resource Department	22	One manager, one supervisor and 20 employees.
	Other departments (IT, student affairs and marketing)	19	Three managers and 16 employees.
<b>E</b> (two branches)	Registration and Administration Departments	47	Two managers, two assistant managers, three supervisors and 40 employees.

	Financial Department	18	One manager, one assistant manager, one supervisor and 15 employees.
	Human Resource Department	28	One manager, two assistant managers, one supervisor and 24 employees.
	Other departments (IT, student affairs and marketing)	12	Three managers and nine employees.
<b>F</b> (three branches)	Registration and Administration Departments	62	Three managers, two assistant managers, three supervisors and 54 employees.
	Financial Department	24	One manager, two assistant managers, one supervisor and 20 employees.
	Human Resource Department	31	One manager, two assistant managers, two supervisors and 26 employees.
	Other departments (IT, student affairs and marketing)	20	Three managers, three supervisors and 14 employees.

#### 4.8.3.2 Ethical Considerations

The ethical considerations in this research were accomplished through two steps to obtain permission in order to start the empirical research. The universities were contacted by the researcher as a first step (university representatives). The second step was to get their approval to allow their staff to participate in this research. Moreover, a consent form was developed by the researcher and attached to the questionnaire. It explained the participants' role so that they could participate voluntarily.

The researcher explained the main objectives of the research study to participants before conducting the survey. Both the English and the Arabic questionnaires were distributed to maintain flexibility. Anonymity was also applied in this research to encourage participation. To protect the participant's identities and to preserve the security and

confidentiality of the research data, the completed questionnaires were kept in sealed envelopes and no person had access to questionnaire data other than the researcher.

#### **4.9 DATA ANALYSIS**

This research applies multivariate analysis (e.g., factors analysis (FA) and structural equation modelling (SEM)) as analytical techniques to revise and examine the proposed model of the adoption of ERP systems by HEIs. The main statistical techniques that will be used in the analysis after collecting the required data are confirmatory factor analysis (CFA), structural equation modelling (SEM) and analysis of variances (ANOVA). CFA will then be applied to confirm or reject the proposed model, as well as to examine the validity of the hypothesised measurement model via convergent validity, Cronbach's alpha and discriminant validity tests. To analyse the data, SEM techniques will then be applied. According to SEM techniques, a t-test of significance will be conducted to test the hypothesised relationships between factors in the research model. The path model will then be utilised to analyse the relationships between the factors in the research model to explain the adoption of ERP systems by HEIs. Finally, ANOVA will be used to determine any demographic (gender, experience, department, level of education, age and marital status) differences on the factors of the study.

##### **4.9.1 Quantitative Validity and Reliability of the Questionnaire**

Content validity implies to "the level that the score or scale being applied symbolizes the notion concerning which generalizations is to be assumed" (Borrmstedt, 1970:91). Davis (1986) argued that producing items from the present literature is anticipated to increase the content validity of the resulting measures. If a measure lacking content validity is employed, researchers may incorrectly interpret the resulting data in terms of the theoretical variable that was intended by the measure, rather than the variable that was actually measured. The validation or revalidation of the instrument is important because instrument validity could be inconsistent between the various groups of users, as well as technologies (Amoako-Gyampah and Salam, 2004).

The instruments in this study have been altered to suit the ERP context. The reason for utilising validated instruments from prior research is to add face validity to this research study. Thus, forty-three items representing ten variables (factors) were utilised in this study. Given the existence of several published articles addressing the variables in this research, measurement items for each variable were adapted from the previous literature in the same field of study. A pilot study was conducted on one university to make sure that the appropriateness of each item facilitates the content validity of the questionnaire.

Assessing the reliability and validity of the questionnaire is the next step after deriving the best-fitting measurement model. Despite the relation between reliability and validity, they are two separate concepts (Bollen, 1989). Reliability is the degree of constancy for a construct or constructs where the index of an instrument is steady (Hair et al., 2006). It implies “the degree to which a measurement item (question) is open of random error” (Nunnally, 1978:191). In other words, as the level of random error increases, reliability is reduced. This study will use a target reliability degree of 0.80, founded on Nunnally’s proposition that “for basic study, it can be claimed that rising reliabilities greatly beyond 0.80 is frequently inefficient of time and finances. At that degree correlations are satisfied extremely little by measurement error” (Nunnally, 1978:245).

Construct validity can be defined as a method that is often used to examine the authenticity and correlation between an indicator or group of indicators used in a study and the internal consistencies of the conceptual model (Bryman and Bell, 2007). Different types of construct validity can be employed by researchers in order to assess their results. Two types of tests will be used in this study to examine the reliability and the validity of measurement scales: convergent validity and discriminant validity. Arnold (2006:197) stated that convergent validity “measures the degree to which the indicators of a latent construct measure the same construct”. In other words, convergent validity examines if the measures for the same construct are correlated, whereas discriminant validity “measures the degree to which two or more latent constructs measure different constructs” (Arnold, 2006:197). Average variance extracted (AVE) and composite reliability (CR)

will be used in this research to assess convergent reliability, as suggested by Fornell and Larcker (1981).

Discriminant validity is fundamental for model evaluation (Hair et al., 2010). It ensures the uniqueness of a construct measure that other measures in a SEM do not catch (Hair et al., 2010). As recommended by Campbell (1960:548), discriminant validity does not require excessively high correlation “with measures from which it is supposed to differ; otherwise, a researcher will not be able to confirm the results of the hypothesised structural paths”. Thus, moderation of factor correlations is required and should not exceed the value of 0.85, as recommended by Kline (1998). In addition, Hair et al. (2006) recommended that discriminant validity is indicated to be significant if the value of the square root of the average variance extracted ( $\sqrt{AVE}$ ) is greater than the  $R^2$  (all item reliabilities) coefficient of the construct.

Cronbach’s alpha – which is a commonly used statistical technique – will be applied to judge the reliability of the questionnaire. Furthermore, to enhance the validity and reliability and to boost the trustworthiness of the research and its results, data screening (via SPSS) will be utilised to inspect data errors prior to conducting factor analysis in order to preserve the consistency and accuracy of the research data. Hair et al. (2010) recommended that a returned survey that consists of missing or repeated data should be eliminated because this method is most appropriate for removing bias evenly.

#### **4.9.2 Pilot Study**

A pilot study is usually accomplished by small scale research in order to re-examine a specific questionnaire (Fink, 2008). According to Kothari (2008), a pilot study is important because it allows the research to recognise impairments in the survey techniques. Meriwether (2001) mentioned that the results gained from the pilot study allow the researcher to modify the collected data prior to conducting the main study. The purpose of the pilot test in this research was to determine if the survey questionnaire was easily understood by the research participants before conducting the main survey.



Peat et al. (2002) identified various procedures to improve the pilot results of a survey questionnaire and such procedures were taken into consideration when the pilot study was conducted as follows:

- Research participants should be asked for their feedback in order to determine the difficulty and the ambiguity of the research questions.
- Ambitious, difficult and unnecessary questions should be discarded.
- Reasonable time should be allocated and recorded to complete the questionnaire.
- The researcher(s) should make sure that all questions are answered and any questions that are not answered as anticipated need to be rephrased and simplified.

Two stages were employed to conduct the pilot test. The first stage consists of four participants (one academic professional, one manager and two employees) who were asked to complete the questionnaire and make any comments regarding its clarity and user-friendliness. The results of this stage showed that minor wording adjustments needed be made to ensure that the questionnaire was clear and easy to follow. The second stage was used to further test the revised questionnaire.

The revised questionnaire was disseminated to diverse stakeholders (management, administration staff and employees) in one university. A total of 20 participants were involved in the pilot test in this second stage. The main purpose of this second stage of the pilot test was to gain feedback from the involved participants to ensure the appropriateness of the revised questionnaire. After the participants answered the revised questionnaire, they were asked to provide their comments and opinions on the parts of the questionnaire that they thought needed to be amended. Their opinions and suggestions were considered during the final preparation of the research questionnaire. The results of this stage led to several amendments, such as reducing the number of questions measuring attitude constructs from five to four questions and modifying the question sequence of the questionnaire.

#### **4.10 SUMMARY**

This chapter has detailed the methodologies that were used in the various parts of the study and explained the techniques that will be employed in the different sections of the research. A positivist's paradigm is chosen as being suitable for conducting this research study. The research employs survey strategy and is quantitative in nature.

The sample in this research consists of ERP users working for HEIs in Saudi Arabia. The data collection method has been discussed in this chapter. The main data collection technique applied in this research was questionnaires. The ethical considerations (e.g., approval, consent, security and confidentiality of the research data) in this research were addressed. Finally, the chapter has also highlighted the main statistical techniques that will be used in the analysis after collecting the required data.

## **CHAPTER FIVE: QUANTITATIVE DATA ANALYSIS – USING MULTIVARIATE ANALYSIS TECHNIQUES**

### **5.1 INTRODUCTION**

The previous chapter (Chapter Four) explained the justifications for the selected research design and methodology for this study. This chapter discusses the different statistical techniques that have been applied to investigate the factors that could affect the adoption of ERP systems by HEIs. Following the introduction to this chapter, the multivariate analysis is discussed in Section 5.2. A comprehensive discussion of the factor analysis and structural equation modelling is presented in Sections 5.2.1 and 5.2.2, respectively. This is followed by Section 5.3 that offers an explanation of the statistical techniques used in the research. The software applications are discussed in Section 5.4, while Section 5.5 summarises the chapter.

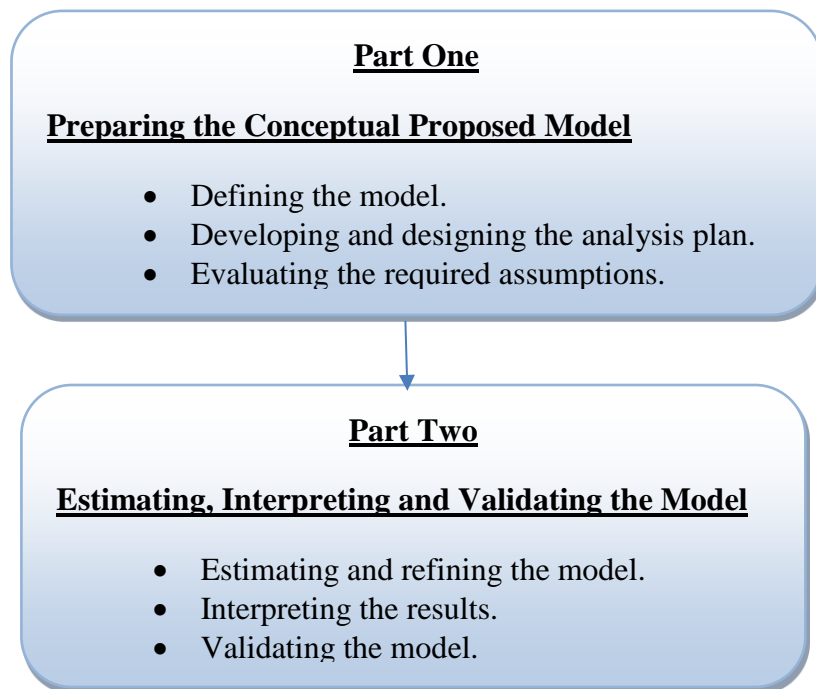
### **5.2 THE MULTIVARIATE ANALYSIS**

Multivariate analysis is concerned with the analysis of variables under study that consecutively exceed three variables (Babbie, 2007). Sharma (1996:5) stated that multivariate analyses are “statistical methods for datasets with more than one independent and/or more than one dependent variable”. He describes such an analysis as “examining differences concerning two or more variables simultaneously” (Sharma, 1996:5). Such a technique can analyse variables that are in single or multiple relationships. Factor analysis, covariance analysis, multiple regressions, variance and multiple correlations are all forms of multivariate analysis.

Multivariate analysis techniques are user-friendly and capable of analysing large datasets and complex models. In addition, the techniques highlight the differences between variables that are similar. Researchers commonly use the multivariate analysis technique in the social sciences to analyse data or massive amounts of information. As discussed in the previous chapters, the TAM proposed by Davis (1986) encompasses various factors and several measurement (observed) variables can measure each factor. The research

model inclusively linked five external factors (organisational and individual factors) to PEOU, PU and intention to use, which was assumed to subsequently affect the actual use of ERP systems in HEIs.

This research applies multivariate analysis (e.g., factor analysis (FA) and structural equation modelling (SEM)) as analytical techniques to revise and examine the proposed model of the adoption of ERP systems by HEIs. In general, the multivariate analysis process consists of two main parts (as displayed in Figure 5.1). Part one is preparing the proposed model by defining the research objectives, developing and designing the analysis plan and evaluating the required assumptions. Part two is estimating, interpreting and validating the model.



**Figure 5.1: Multivariate Analysis Process.**

As shown in Figure 5.1, the first part of the multivariate analysis process is defining the conceptual model. The conceptual model represents the relationships between variables.

The next step is developing and designing the analysis plan, which takes into consideration the sample size and the way of measuring the variables. The last step is evaluating the required assumptions – both theoretical and statistical – that must be met before testing the model.

In the second part, the model will be estimated and evaluated according to statistical criteria. In this stage, the model may be refined to reach an acceptable level of model fit. Multivariate relationships can be interpreted after estimation of the acceptable model. The final stage is validating the model and deriving appropriate generalisations from it. Sections 5.2.1 and 5.2.2 describe FA and SEM techniques in greater detail.

### **5.2.1 Factor Analysis (FA)**

Factor analysis is an empirical method that involves defining the existing correlation of a large number of variables. Kerlinger (1979:180) defined factor analysis as “an analytic method for determining the number and nature of the variables that underlie larger numbers of variables or measures”. It is important to note that the procedures in factor analysis are not based on a single statistical method, but on a set of statistical analyses that can be used to examine a set of observed variables. The statistical and theoretical variations within these procedures allow the researchers to utilise different tools across different applications and disciplines.

Factor analysis informs the authors of what analyses and tests belong together. Stapleton (1997:16) stated that “the process of factor analysis results in the smallest and most compatible number of underlying factors from a larger set of initial variables on a test or instrument”. Additionally, one of the purposes of factor analysis is to summarise the relationships between variables that can help in providing more accurate conceptualisation (Gorsuch, 1983). Gorsuch (1983:2) stated that “all scientists are united in a common goal: they seek to summarise data so that the empirical relationships can be grasped by the human mind”.

Factor analysis can either be exploratory factor analysis (EFA) or confirmatory factor analysis (CFA), depending on the intended outcome when conducting research. In EFA, researchers try to find a model that fits the data. While in CFA, researchers try to statistically test the significance of the proposed model. Both techniques share some similarities. For instance, CFA and EFA are statistical techniques used to examine the internal dependability of a given quantity. They are both qualified in the investigation of theoretical conceptions or factors generated by item groups. CFA and EFA can both choose to assume that factors present are possibly unconnected or orthogonal. In addition, they can be used in the assessment of the quality of distinct items. However, according to Stevens (1996), there are differences between both techniques – as illustrated in Table 5.1.

**Table 5.1: Differences between EFA and CFA.**

EFA	CFA
Numbers of factors were explored.	Numbers of factors were specified.
Correlations between factors were explored.	Correlations between factors were defined.
Observed variables measuring each factor were explored.	Observed variables measuring each factor were defined.
The theoretical model does not exist.	The theoretical model was specified.

Source: Stevens (1996).

Based on the differences between EFA and CFA that have been highlighted in Table 5.1, it seems that CFA is the more appropriate analysis method for this study for the following reasons:

- The third objective of this research study (see Chapter One) is to identify the factors affecting the adoption of ERP systems in the HEIs of Saudi Arabia and

develop a theoretical model for ERP adoption in the HEIs of Saudi Arabia. Thus, the reviewed literature facilitates sufficient background regarding the level of study in the context of users' acceptability within the general IT field and, particularly, the ERP field. Additionally, the literature review facilitates the choice of the baseline replica that is engaged to verify the significant main factors affecting the adoption of ERP systems in HEIs.

- . Given the existence of numerous published articles dealing with the variables in this study (encompassing those discussed previously in Chapter Three), a literature review within the TAM context was employed to identify the last set of indicators (observed variables) for every latent variable within this research. Generating items from the literature has two benefits over the express elicitation of items (Davis, 1986). Initially, there is a rich set of published articles available to draw from, numerous of which have themselves used quantitative study methods to understand how subjects consider these constructs. Subsequently, these existing articles cut across a broad variety of objective systems, user populations and usage environments.
- The factors identified in this study have been validated in different empirical studies and have strong support in the literature. Thus, based on literature review and TAM, the hypothesised relationships between factors were developed and the proposed model of this research was constructed.

According Hair et al. (2006), the objective of the EFA is data reduction or data summarisation. In data reduction, EFA is used to create a new set of variables to replace the original set. While in summarising the data, EFA describes the data in a smaller number of variables than the original variables. In other words, the data summarisation method is applied in order to determine the number of factors that could be included in the proposed models.

CFA, however, is exploratory in nature (Gerbing and Hamilton, 1996). For example, when the theory being tested does not fit, CFA uses modification indices. Such approach helps unspecified CFA to become a good representation of a data set. In other words, if the author makes few changes on the data parameters, the CFA turns into an EFA. Gerbing and Hamilton (1996:71) stated that “most uses of confirmatory factor analyses are, in actuality, partly exploratory and partly confirmatory in that the resultant model is derived in part from theory and in part from a re-specification based on the analysis of model fit”. Based on the above discussion, the number of factors in the current study has been selected based on TAM and the previous literature in technology acceptance. The next subsections will discuss the considerations for factor analysis and CFA in more detail.

#### **5.2.1.1 Considerations for Factor Analysis**

Before starting data analysis, a number of conceptual and statistical assumptions must be made. Conceptual assumptions relate to the factors that are selected and to the relationships between those factors. All of the conceptual assumptions about factors and the relationships between them have theoretical underpinnings (see the discussion in Chapter Three).

In terms of statistical assumptions, because the purpose of factor analysis is to identify interrelated groups of factors, the intensity of multicollinearity becomes vital. It is necessary to examine the absence of singularity and multicollinearity in a given set of data (Tabachnick and Fidell, 2007). Multicollinearity occurs if strong correlations between two or more factors were dictated (Hair et al., 2006). Multicollinearity is the extent to which a variable can be statistically explained by the other variables in the analysis (Hair et al., 2006). In addition, before applying factor analysis, the validation of data for factor analysis should be examined. If visual inspection reveals no substantial number of correlations greater than 0.3 (Tabachnick and Fidell, 2001), then factor analysis is probably inappropriate because anything lower than that would indicate a weak link in the variables (Tabachnick and Fidell, 2007).



Partial correlation among variables could be used to analyse the correlation among variables. A partial correlation is the correlation that is unexplained when the effects of other variables are taken into account. If the partial correlations are high (greater than 0.7), then the factor analysis is inappropriate because the variables cannot be explained by the variables loading on the factors. SPSS provides the anti-image correlation matrix, which is the negative value of the partial correlation.

Bartlett's Test of Sphericity is another method of determining the appropriateness of factor analysis (Beavers et al., 2013). According to Field (2009) and as cited by Al-Hadrami (2012:139), the Bartlett's Test of Sphericity is a test to "examine whether a variance-covariance matrix is proportional to an identity matrix". The test is a chi-square assessment used to investigate the hypothesis that states that variables are not correlated in given populations. Additionally, it examines the strength of relationships between variables and provides suggestions regarding the factorability of these variables (Field, 2009; Beavers et al., 2013).

As this study seeks to develop a conceptual model of the main factors affecting the adoption of ERP systems in HEIs through the use of secondary data (previous literature on ERP systems) and primary data (questionnaire), it is important to make sure that the generated data is appropriate for factor analysis by examining whether the correlation matrix has significant correlations among at least some of the variables. The Bartlett's test can be used to achieve this purpose. It investigates the correlations in the dependent variables and establishes if, collectively, the significant correlations exist. In other words, the test indicates whether the variables are correlated. This means that the generated data is appropriate for factor analysis. Practically, the Bartlett's test is highly significant if the value of the chi-square test is less than 0.05, implying that the variables are correlated among themselves. Values greater than 0.05, however, indicate that the generated data is inappropriate for factor analysis (Kaplan, 2004).

In addition to the Bartlett's Test of Sphericity, Kaiser-Meyer-Olkin's (KMO) measure of sampling adequacy (MSA) tests will be applied to determine the appropriateness of factor

analysis. According to Field (2009) – as cited by Al-Hadrami (2012:139) – the MSA can be “calculated for multiple and individual variables and represents the ratio of the squared correlation between variables to the squared partial correlation between variables”. KMO is a statistical test that examines the shared variance in the research items that might be caused by underlying factors and it ranges from 0 to 1. If the KMO value is less than 0.5, then the factor analysis can be considered inappropriate. However, if the value is 1, or close to 1, then the factor analysis is valid. To ensure that the statistical assumptions of factor analysis were met in this research, all of the above methods will be used.

#### **5.2.1.2 Confirmatory Factor Analysis (CFA)**

Tate (1998:311) defined confirmatory factor analysis as “a statistical analysis which is conducted to estimate and test the hypothesised measurement model for all latent variables having more than one observed indicator. Model revisions are made, if necessary, to arrive at a model adequately fitting the data”. Constructs are unobservable variables that cannot be measured directly but can be represented or measured by one or more variables called indicators. Unobserved variables are sometimes called latent variables.

CFA is usually used in data analysis to test the relationships between variables (Hurley et al., 1997). In other words, in instances whereby the researcher is interested in examining different concepts and relationships to portray the strengths of a pre-determined factor model that is in line with an observed set of data, then the CFA is applied. In CFA, researchers try to statistically test the significance of the proposed model. In addition, the researchers have a priori-specified theoretical model (which is the case of this study). Thus, CFA will be performed in this research to examine the relationships between variables (organisational, individual and TAM factors) and to confirm or reject the proposed model.

The CFA is made up of a design that is closely fitted with data, a statistical method used to measure the approximated model for all latent variables that carry with it multiple indicators (Tate, 1998). CFA assists in eliminating errors that are associated with the path

model by taking advantage of several observed variables per unobserved variable (Garson, 2009).

The examination done on the CFA is comprised of the estimation of the covariance matrix followed by sequenced assessment and practice to show the degree of fit of the covariance matrix. Alterations of the measurement model will be made after the standardised residuals as well as the modification indices were analysed, as recommended by several researchers (Byrne, 1998; MacCallum, 1986; Segars, 1997). The model modifications should be conducted gradually (one at a time) because any slight alteration on the model may influence other parts of the resolution (Holmes-Smith et al., 2006). According to Garson (2009), in order to enhance the goodness-of-fit for the proposed models, variables with undesirable estimates – such as large standard errors, negative variances and standardised coefficients  $>1.0$  – should be deleted.

As the utmost objective of this research study is to develop a model of factors affecting the adoption of ERP systems by HEIs, the model should be authentic and considerable and should be well-fitting the data statistically. To achieve this, the general guidelines for identification criteria suggested by Bollen (1998) were taken into consideration. He advised that:

- Each unobserved variable should have at least two observed variables
- Factors should be correlated
- Each observed variable was determined by only one unobserved variable
- Any measurement errors should be uncorrected

CFA is used to test any model by comparing the two matrices. Models that produce an estimated covariance matrix that is within the sampling variation of the observed covariance matrix are generally thought of as good models and would be said to fit well. That is to say, the difference between two matrices plays a key role in determining the fit of the CFA model, where a small value of difference is acceptable for use. Unlike SEM,

CFA does not need to distinguish between dependent (endogenous) variables and independent (exogenous) variables. Latent variables could be independent or dependent variables. Using CFA, only the loadings theoretically linking a measured item (observed variable) to its corresponding latent factor (unobserved variable) are calculated.

In this research, both SEM and CFA will be applied to examine the validity of the hypothesised measurement model (Tabachnick and Fidell, 2007). Two comparison steps between the CFA model and the SEM model will be performed to assess the validity of the structural model prior to the path analysis. Loading estimates will be performed on the structural model as the first step and the constructs' variations will be reported. The purpose of using loading estimates was to support the structural model's validity and ensure the consistencies of factor-loading estimates are unchangeable for both models. The next step will be to examine the goodness-of-fit for the structure model, as well as to perform a comparison between the model fit measures that stemmed from the CFA model and the structural model.

#### **5.2.1.2.1 CFA Notations**

Figure 5.2 illustrates the notation used in CFA. The two-way arrows represent covariance or correlations between factors. A one-way arrow from a factor to an observed variable represents regression coefficients or factor loadings, indicating the degree to which an underlying factor is measured by the variables. A one-way arrow from an error term to a variable represents the error associated with that variable.

Figure 5.2 contains seven observed (measured) variables ( $X_1$  to  $X_7$ ), two latent factors ( $F_1$  and  $F_2$ ), and seven error terms ( $e_1$  to  $e_7$ ).  $L_{1,1}$  to  $L_{4,1}$  and  $L_{5,2}$  to  $L_{7,2}$  represent the relationships between the latent variables and the respective measured items (factor loadings).  $Q_{1,2}$  represents the covariance matrix between two factors ( $F_1$  and  $F_2$ ). Mathematically, for example, the observed variable ( $X_1$ ) can be represented in the following equation:

$$X_1 = L_{1,1} F_1 + e_1$$

The above equation is based on reflective measurement theory because CFA uses the concept of reflective rather than informative measurement theory. Reflective measurement theory is based on the idea that latent constructs cause the measured variables and that the error results in an inability to fully explain these measures. Because of that, the arrows are drawn from latent variables to measured variables. As an example, intention to use ERP systems is believed to cause specific measured indicators, such as: IU<sub>1</sub>, IU<sub>2</sub>, IU<sub>3</sub> and IU<sub>4</sub>. Dropping the measured indicator, therefore, does not change the latent construct's meaning. Variables with low factor loadings can be dropped from reflective models without serious consequences, as long as a construct retains a sufficient number of indicators.

Informative measurement theory is based on the assumption that the measured variables cause the construct and that the error is an inability to fully explain the construct. As an example, social class is often viewed as a composite of one's educational level, occupational prestige and income. Dropping variables will decrease the total correlations. Typical social science constructs – such as attitudes, personality and behavioural intentions – fit the reflective measurement model well (Bollen and Long, 1993). Figures 5.3 and 5.4 illustrate the reflective measurement theory and informative measurement theory, respectively.

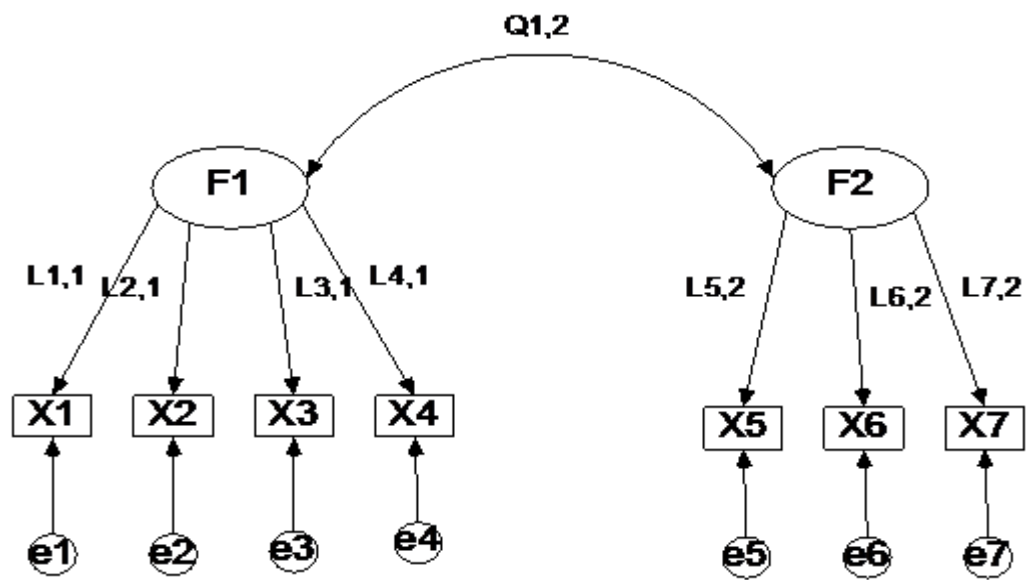


Figure 5.2: CFA Notations.

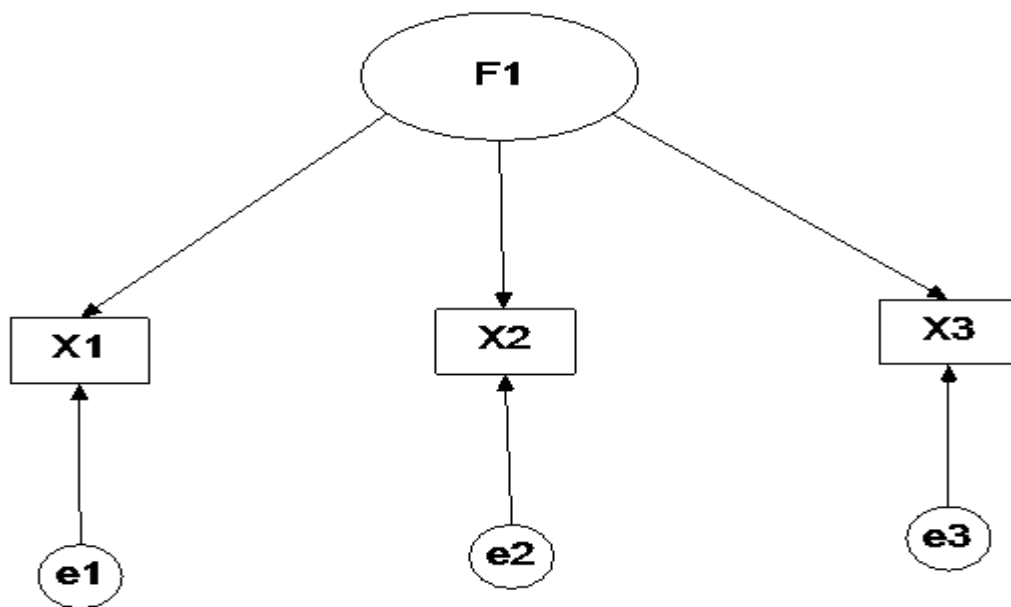
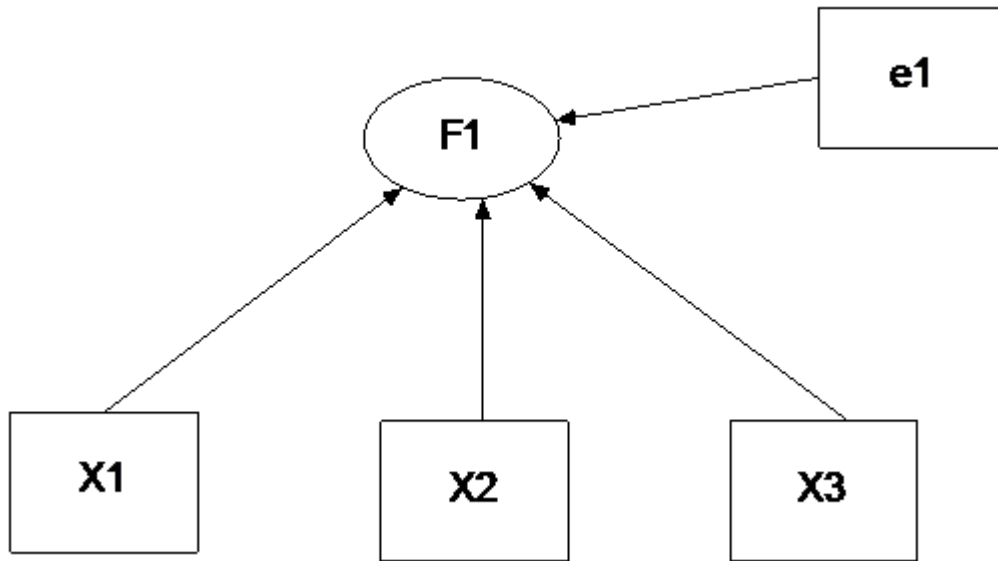


Figure 5.3: Reflective Theory.



**Figure 5.4: Informative Theory.**

#### **5.2.1.2.2 Assessing the Model's Validity and Reliability**

Stapleton (1997:9) stated that “factor analysis, long associated with construct validity, is a useful tool to evaluate score validity”. Assessing reliability and validity of the questionnaire is the next step after deriving the best-fitting measurement model. Convergent validity and discriminate validity tests will be used to examine the reliability and the validity of the measurement scales. Arnold (2006:197) stated that convergent validity “measures the degree to which the indicators of a latent construct measure the same construct”. In other words, convergent validity examines whether the measures for the same construct are correlated; whereas, discriminant validity “measures the degree to which two or more latent constructs measure different constructs” (Arnold, 2006:197).

Average variance extracted (AVE) and composite reliability (CR) will be used in this research to assess convergent reliability, as suggested by Fornell and Larcker (1981). According to Fornell and Larcker (1981), if the value of AVE is equal or above 0.5, this is an indication that the reliability of the questionnaire is good. To confirm convergent

validity, all factor loadings for the same construct should be higher than 0.7 (Gefen et al., 2000). Additionally, AVE and CR values for the measurement model should be above 0.5 and 0.7, respectively (Fornell and Larcker, 1981; Hair et al., 2010).

In order to assess the internal consistency among items in the questionnaire, Cronbach's alpha – which is a commonly used statistical technique – will be used to judge the reliability of the questionnaire. Cronbach's values range from 0 to 1 and measure the extent to which items in the questionnaire are correlated or associated with one another. According to Nunnally (1978), the questionnaire can be considered highly reliable when the Cronbach's alpha value is higher than 0.7.

Discriminant validity is the extent to which a given construct is truly distinct from other constructs and is said to be present when the correlations between indicators measuring different factors are not excessively high and, therefore, factor correlations are only moderately strong (e.g.,  $< 0.85$ ) (Kline, 1998). Thus, high discriminant validity provides evidence that a construct is unique and captures some of those phenomena other measures do not. In addition, Hair et al. (1998) recommended that if the value of the square root for the average variance extracted ( $\sqrt{\text{AVE}}$ ) is greater than the  $R^2$  coefficient of the construct, this is an indication that discriminant validity is significant.

In addition to the convergent validity of discriminant validity tests, inter-item correlations for a measurement item were applied. According to Bollen and Lennox (1991), inter-item correlations enhance the validity of the research by providing researchers with information regarding whether the item has only one dimension or not. Jaber (2012:174) stated that “homogeneity of the scale items is assessed by inspecting the inter-item correlations”. According to Robinson et al. (1991), correlation coefficients that are greater than 0.3 are significant at the 0.01 level.

### **5.2.2 Structural Equation Modelling (SEM)**

SEM is used for different purposes. For example, SEM helps the researcher to design the association of several dependent and exogenous constructs concurrently (Fornell and



Larcker, 1981). SEM portrays first-hand connections for each group of dependent variables. In addition, it offers relevant and efficient estimations for an array of discrete multiple regression equations that are assessed simultaneously. Also, SEM is used because it allows the simultaneous analysis of both observed and unobserved variables in a single-group analysis (Byrne, 1998).

SEM is characterised by two basic components: measurement and structural models. A measurement model uses several variables for a single independent or dependent variable. The procedure for testing the hypothesis of linkages between observed variables and their underlying latent variables is CFA. In other words, CFA represents the measurement model. The structural model is the path model, which is independent of the dependent variables. SEM tests the hypotheses of linkages among latent variables. In other words, SEM represents the structural model. CFA alone is limited in its ability to examine the nature of relationships between variables beyond simple correlations (Hair et al., 2006). Hence, path analysis will be performed to the structural equation model after having concealed variables to assess the assumed relationships that predict the actual use of ERP systems by HEIs. Path values are statistically significant if the critical ratio or the t-value is greater than 1.96 at 0.05 levels (Hair et al., 2010).

The results of a structural model will not be considered unless coefficients of determination ( $R^2$ ), as well as indirect effects for structural equations, are reported in the quantitative model (Schreiber et al., 2006). Schreiber et al. (2006) stated that “the relative importance of individual factors and their corresponding effects on one or more outcomes cannot be understood fully unless results have been reported in terms of direct, indirect, and total effects”. Also, the results of  $R^2$  can be used to evaluate the magnitude of the dependence relationships by assessing the extent to which the endogenous constructs (independent constructs) explain variance in the exogenous constructs (dependent constructs; McQuitty and Wolf, 2013).

### **5.2.2.1 Model Estimation**

In this step, each of the parameters specified in the model must be estimated to produce an estimated covariance matrix. Thereafter, the difference in the estimated covariance matrix and observed covariance matrix can be calculated. If the observed covariance matrix equals zero, then chi-square ( $\chi^2$ ) will equal zero and this will produce the perfect model fit to the data. To reduce the difference between the covariance matrix and the observed covariance matrix, a particular fitting function – such as Ordinary Least Square (OLS) – can be utilised. However, the maximum likelihood estimation (MLE) has been employed in the early versions of the Linear Structural Relations (LISREL) program and became the most commonly used estimation method employed in most SEM programs (e.g., AMOS).

In addition, MLE was compared with other techniques and produced reliable results under many circumstances (Olsson et al., 2000). MLE is a procedure that iteratively improves parameter estimates to minimise a specified fit function. MLE requires normally distributed and definite positive variables (Garson, 2009). The MLE technique interactively enhances parameter estimations to reduce a stated fit function. It is selected as one of the approaches of data screening in this research (Bollen, 1989)

### **5.2.2.2 Model Testing**

The ability to evaluate whether a given model can integrate the data is a crucial stage in SEM (Yuan, 2005) because a researcher should be able to make an appropriate decision on whether the data fits the model. The core theory of the model that best represents the data is the model fit indices. Indices of model fit exist in several forms and rely on goodness-of-fit (GOF). Corresponding observed variables are loaded on the proposed factors when conducting the CFA to determine whether goodness-of-fit measures are relevant in this study. Hair et al. (2006) advised using three indices in each of the model fit categories: absolute, parsimonious and incremental. However, Kline (1998) suggested that authors should use at least four indices, such as: the Goodness-of-fit Index (GFI), the Normed Fit Index (NFI), chi-square, the Comparative Fit Index (CFI) or the Root Mean

Square Error of Approximation (RMSEA). All these indices were applied in the measurement of the data fit for the model proposed in this research (see Table 5.2).

### **Model Chi-square ( $\chi^2$ )**

The chi-square value is the oldest approach used to evaluate the whole model fit as well as “evaluating inconsistency degree as interpreted from the sample and fitted matrices” covariance (Hu and Bentler, 1999:2). Simply put, chi-square is the most popular goodness-of-fit test used for SEM (Garson, 2009). The model chi-square ( $\chi^2$ ) is also known as the discrepancy function. A value of less than three is frequently suggested to be minimally acceptable (Kline, 1998).

### **Goodness-of-Fit Index (GFI)**

GFI is an immediate measure of total fit, indicating how close the model replicates the covariance matrix observed (Diamantopoulos and Siguaw, 2000). It discusses the part of the observed covariances introduced by the model (Garson, 2009). This index is also a minimisation in sensitivity to the sample. The GFI value fluctuates between 0 and 1, and researchers have proposed that the standard GFI value must be equal to or greater than 0.90 (Hair et al., 2006).

### **Adjusted Goodness-of-Fit Index (AGFI)**

AGFI considers the model complexity. Compared to GFI, AGFI has a built-in adjustment about the degree of freedom complexity model (Jöreskog and Sörbom, 1993). Similar to GFI, AGFI values increase as the size of the sample increases (Garson, 2009). The AGFI value usually ranges from 0 to 1 (Jöreskog and Sörbom, 1988). AGFI values are lower than GFI, and the value 0.8 or higher is considered to be an acceptable fit to the data (Segars and Grover, 1993).

### **Root Mean Square Error of Approximation (RMSEA)**

RMSEA highlights the advantages of the model by uncovering the optimally selected parameter approximations fitting the covariance matrix of populations (Byrne, 1998). In recent years, the RMSEA has been rated as “one of the greatest explanatory fit indices”

(Diamantopoulos and Siguaw, 2000). This is due to the sensitivity of RMSEA to the estimated number of parameters in the model.

The RMSEA's main advantage is that it can allow a confidence interval to be worked on its value (MacCallum et al., 1996). An RMSEA value that is greater than 0.03 and less than 0.08 records a good model fit (Hair et al., 2006). The approach is a popular measure of fit because there is no need to compare the SEM model with a null model (Baumgartner and Homburg, 1998).

### **Normed Fit Index (NFI)**

NFI is an alternative index of CFI. NFI is an index that assesses goodness of a specified model fit compared to some of the alternative null models. The null model is a model that hypothesises that all variables observed are not correlated. NFI ranges from 0, which is poor, to 1, which is a perfect fit; an NFI value that is equal or above 0.90 is acceptable (Tate, 1998).

### **Comparative Fit Index (CFI)**

CFI is an upgraded version of the NFI. CFI is also referred to as the Bentler Comparative Fit Index. This index is used to indicate the enhancement of the overall fit of the SEM model when compared to the null model (Garson, 2009). The CFI is encompassed in all SEM programs and is one of the commonly reported fit indices, owing to it being one of the measures less impacted by the size of the sample (Hair et al., 2010). A CFI value close to 1 indicates an excellent model fit (Hair et al., 2010). Normally, CFI has to be greater than or equal to 0.90 for a model to be accepted (Kelloway, 1998).

**Table 5.2: The Recommended Cut-off Value for each of the Discussed Indices.**

<b>Index</b>	<b>Recommended Cut-off Value</b>	<b>Recommended by Author(s)</b>

The ratio of chi-square to degrees of freedom ( $\chi^2/\text{df}$ )	$\leq 3$	Chin and Todd (1995); Kline (1998)
Goodness-of-fit index (GFI)	$\geq 0.90$	Hair et al. (2006)
Adjusted goodness-of-fit index (AGFI)	$\geq 0.80$	Segars and Grover (1993)
Root mean square error of approximation (RMSEA)	0.03–0.08	Hair et al. (2006)
Normed fit index (NFI)	$\geq 0.90$	Tate (1998)
Comparative fit index (CFI)	$\geq 0.90$	Kelloway (1998)

### 5.2.2.3 Model Modification

The modification approach is carried out after undertaking a serious investigation to identify areas that need to be changed. The adjustment is necessary in situations where data fails to incorporate with the theoretical model. The model will then be modified by the use of the modification index and the specification search. In the specification search, the aim is to modify the original model in the search for a model that is better fitting in some sense and yields parameters that have practical significance. AMOS (version 23) includes a specification search.

The modification index is also known as a Lagrange Multiplier. Tate (1998:193) stated that the multiplier is “the approximate improvement in overall model fit (expressed as a decrease in the chi-square) if that path is added to the model”. After designing the original SEM model, model redesigning involves extreme fitting of the model with arrows and the termination of the parameter will be carried out to enhance the acquisition of a more relevant model with goodness-of-fit parameters (Garson, 2009); although no optimal strategy has been found (Hair et al., 2006).

In this research, the modification index will be used because Jöreskog and Sörbom (1993) advised that the method appeared to work harmoniously when initiated in practice. The

final model produced from this stage will contain a complete set of constructs and indicators in the measurement model. In addition, the final model will indicate the structural relationships among the constructs.

### **5.3 RESEARCH STATISTICAL TECHNIQUES**

According to Schumacker and Lomax (1996), there are various statistical methods used in the field of statistical analysis, which include relational, descriptive and inferential statistics.

#### **5.3.1 Relational Statistics**

In this category of statistics, calculations are grouped into bivariate, univariate and multivariate analysis (Babbie, 2007). Bivariate analysis is studying the interconnection or relationships between two variables. Univariate analysis is the testing of one variable and its characteristics. Multivariate analysis is concerned with the analysis of more than three variables under study (Babbie, 2007). Such techniques can analyse variables that are in single or multiple relationships. As the fourth objective of this research is to examine the relationships and relevancy among the factors influencing the adoption of ERP systems by HEIs based on the TAM model (see Chapter One), it is most appropriate to utilise multivariate analysis techniques. CFA and SEM are the techniques of multivariate analysis that will be applied in this research.

#### **5.3.2 Descriptive Statistics**

This type of statistics aids the researcher in producing and presenting the relevant findings of any research process. Much of the focus is directed on acquiring the mean of any presented data, which is one of the main ingredients used in the measure of central tendency. However, it does not ignore other measures of central tendency such as variance and standard deviation. To acquire an average in the score of the feedback from any test, the mean is applied. This is done by adding up all the numbers and then dividing the sum by the number of available results (Forzano, 2008). For instance, the means identify the average frequency distribution number.

On the other hand, standard deviation shows the exact measurements of the result either below or above the mark (Fink, 2008). In cases where the results gathered indicate lower numbers than the standard deviation, the results are similar to minor variations. However, large values of difference indicate that the results acquired lack consistency (Forzano, 2008). Descriptive analysis of the sample was applied in this research – such as standard deviation and the mean – in the process of data analysis.

### **5.3.3 Inferential Statistics**

Inferential statistics have been labelled the easiest method to apply when conducting research since the technique largely depends on assumptions. Sampling is recognised as the champion approach to adopt in inferential statistics; this is because researchers are able to carry out minimal experiments with a given population or geographical location and make justifiable assumptions about the population at large by basing the conclusion on the sample result (Diamantopoulos and Schlegelmilch, 2000).

The results derived from a study population are presented empirically as p-values (Forzano, 2008). The p-values are rated in an ascending order, whereby results with higher p-values are said to have a reduced likelihood of correlation between the variables under review (Fink, 2008; McClave et al., 2008). For example, a p-value of 0.05 picked out randomly shows that the population mean score lies within the numbers indicated in the range with a high likelihood of 95% (McClave et al., 2008).

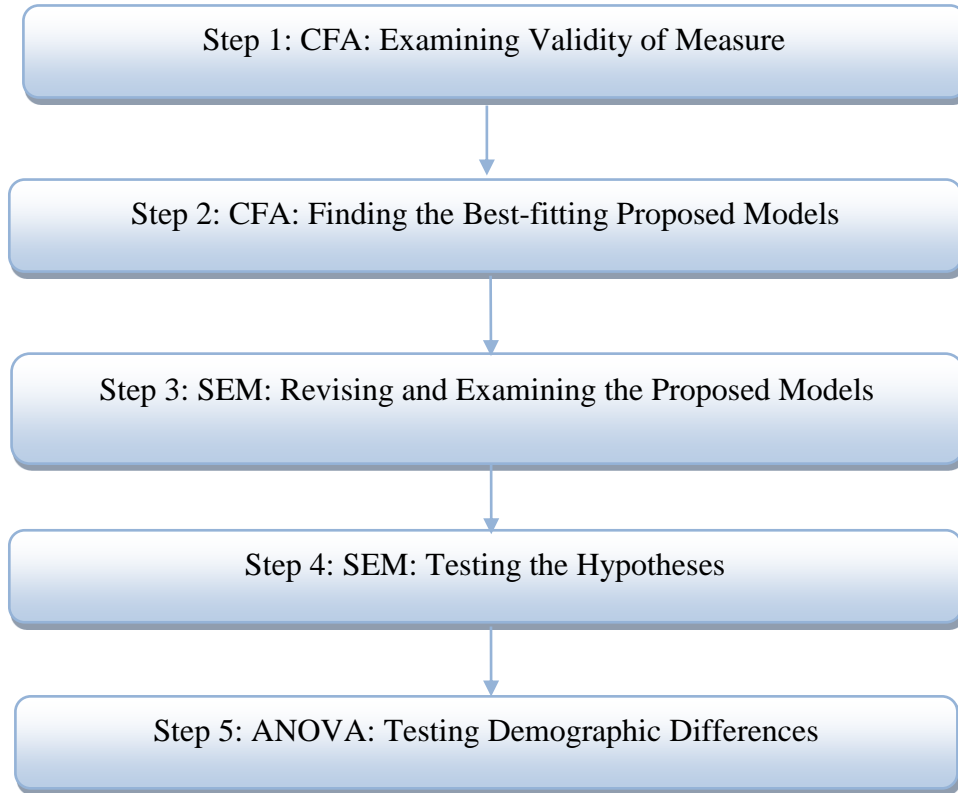
Inferential statistics are usually utilised in order to examine the differences within groups as well as to test relationships (cause and effect) among a group of variables. According to Cooper and Schindler (1998), inferential statistics encompass different types of tests, such as: Pearson's correlation coefficient, the chi-square test, the t-test and one-way analysis of variance.

Inferential statistics are categorised as parametric statistics and non-parametric statistics. Parametric statistics refer to testing statistical hypotheses while non-parametric statistics

are known as population estimations of values (Steinberg, 2008). Non-parametric statistics (e.g., chi-square tests) are frequently used when there are no systematic orders and rules in the way things operate, such as in a case of examining nominal data. Alternatively, in cases where the data under review has some priority connected with them – such as Likert-scale responses – the t-test or analysis of variances (ANOVA) – that are examples of parametric statistics – could be applied.

This research applied both methods to analyse the statistics. Pearson's correlation coefficients and chi-square tests were used in the CFA stage to guide the formation of conclusions. Then, the t-test and the ANOVA analysis approach were employed to identify anomalies among the different groups in the sample. In this research, different steps and techniques were applied to analyse the quantitative data – as shown in Figure 5.5.





**Figure 5.5: The Main Steps and Statistical Techniques Used in the Analysis.**

The first validity of measures will be performed with the help of CFA on the proposed measurement model. The examination done on the CFA comprised the estimation of the covariance matrix followed by sequenced assessment and practice to show the degree of fit about the covariance matrix. SEM CFA will be applied to examine the validity of the hypothesised measurement model. Both discriminant validity and convergent validity will be evaluated. By testing the research model through SEM, the advocated proposed structural model will be revisited and examined. Finally, the ANOVA technique will be carried out to determine demographic differences that arise over the factors of the study.

## **5.4 SOFTWARE APPLICATIONS FOR DATA ANALYSIS**

To address the research problem, the researcher realises the need to integrate the ideas of SEM that involves the application of AMOS (version 23) and SPSS (version 20) software. In the research, SPSS will be used to provide a descriptive analysis of the sample, such as standard deviation and the mean. AMOS is user-friendly and designed to offer several indices of goodness-of-fit measures with a combination of SPSS (Garson, 2009). AMOS specifies the parameters to be fixed and estimated and was also among the first SEM programs to simplify the interface so that a researcher could perform analysis without having to write any computer code. AMOS was utilised in this research study to examine the significance of path value.

## **5.5 SUMMARY**

This chapter presents the quantitative data analysis by the use of multivariate analysis techniques. It applies multivariate analysis (e.g., FA and SEM) as analytic techniques to revise and examine the proposed model of the adoption of ERP systems by HEIs. The chapter explained the factor analysis concept and it showed the difference between EFA and CFA. Moreover, the chapter discussed the CFA and its objectives. This chapter detailed the assessment of validity and the assessment of fit of both the measurement and structural models. In addition, the relational, descriptive and inferential statistical techniques were also discussed. Finally, AMOS and SPSS softwares were used in this research to analyse the data. The next chapter will discuss the results of the analysis performed on the questionnaires.

## **CHAPTER SIX: RESEARCH FINDINGS**

### **6.1 INTRODUCTION**

This chapter presents the results of the data analysis for the quantitative research and hypotheses tests. Different statistical techniques have been applied to investigate the factors that may affect the adoption of ERP systems by HEIs. This research has developed an extended version of TAM in order to examine the factors that affect the adoption of ERP systems by HEIs located in Saudi Arabia. The main part of the chapter focuses on defining the underlying structure between the factors in the analysis.

Confirmatory factor analysis (CFA) was applied to confirm or reject the proposed model as well as to examine the validity of the hypothesised measurement model via convergent validity and discriminant validity tests during the CFA stage. The next stage encompasses the application of structural equation modelling (SEM) in order to examine the relationships between unobserved and observed variables. Finally, an Analysis of Variance (ANOVA) technique was carried out to determine demographic differences that arise over the factors of the study.

Building upon previous research in the field of IT, a modified TAM model was hypothesised for the adoption of the ERP systems. According to TAM, the actual use of the system is determined by behavioural intention. Thus, in this research study, the research model was extended to encompass the actual use (USAGE) of ERP systems.

### **6.2 DEMOGRAPHIC DESCRIPTION OF THE SAMPLE**

The participants in the current study were individuals who used ERP systems from six universities in Saudi Arabia and who worked mainly in different university departments, such as finance, registration, human resources, marketing, student affairs and IT. Between November, 2016, and February, 2017, the research data was collected by the use of self-administered questionnaires. A total of 600 questionnaires were circulated to the targeted universities. The distributions of the responses to the survey questionnaire received are

provided in Table 6.1, showing the frequency and the percentage of respondents for each university. Only 463 responses were returned, giving a response rate of 77.1%. However, 69 responses were excluded from the analysis because they were incomplete or had missing data values and, thus, 394 responses were found to be useable and valid for conducting the final analyses.

**Table 6.1: The Distribution of Responses by University.**

<b>University</b>	<b>Frequency</b>	<b>%</b>	<b>Cumulative (%)</b>
University A	83	18	18
University B	45	9	27
University C	49	11	38
University D	69	15	53
University E	93	20	73
University F	124	27	100
<b>Total</b>	<b>463</b>	<b>100</b>	<b>100</b>

Table 6.2 provides a summary of the demographic data from the responses. The sample indicates that 62.9% of respondents were male, whereas only 37.1% were female. Interestingly, 42% of the respondents had more than six years of experience in using ERP systems. The use of ERP systems across the different university departments was: 28.7% in registration departments, 25.9% in human resources departments, 23.6% in finance departments and 21.8% across other departments. In addition, more than half of the respondents held an undergraduate degree or higher (48.2% had an undergraduate degree and 11.2% had a postgraduate degree) and 40.6% of respondents were between 20 and 29 years old. Moreover, Table 6.2 shows that 40.1% of the participants lived in Riyadh (the capital of Saudi Arabia) and that more than half of the participants (56.6%) were married. The analysis indicates that the majority of the research's respondents were male, experienced, highly educated, middle aged and married.

**Table 6.2: Demographic Data Summary.**

<b>Variable</b>	<b>No. of Respondents</b>	<b>Percentage (%)</b>
<b>Gender</b>		
Male	248	62.9
Female	146	37.1
<b>Experience</b>		
Less than one year	51	12.9
1–3 years	63	16.0
3–6 years	113	28.7
More than six years	167	42.4
<b>Department</b>		
Finance departments	93	23.6
Registration departments	113	28.7
Human resources departments	102	25.9
Other departments (IT, student affairs and marketing)	86	21.8
<b>Education</b>		
High school or less	55	14.0
Diploma	105	26.6
University degree (BA)	190	48.2
Masters or PhD	44	11.2
<b>Age</b>		
Under 20 years	20	5.1
20–29 years	160	40.6
30–39 years	155	39.3
40 years and above	59	15.0
<b>Place of Residence</b>		
Riyadh	158	40.1
Jeddah	25	6.3
Dammam	55	14.0
Other	156	39.6
<b>Marital Status</b>		
Single	160	40.6
Married	223	56.6
Other	11	2.8

## 6.3 FINDINGS REGARDING THE APPROPRIATENESS OF FACTOR ANALYSIS

### 6.3.1 Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) Test

In the current study, the Bartlett's test was applied to the factors affecting ERP adoption in HEIs. Bartlett's test is highly significant if the value of the chi-square test is less than 0.05, implying that the variables are correlated among themselves; while values greater than 0.05 indicate that the generated data is inappropriate for factor analysis (Kaplan, 2004). Table 6.3 shows that the overall results of the Bartlett's test investigations are appropriate for factor analysis, with  $\chi^2_{903} = 18,591.172$  and  $p < 0.05$ .

**Table 6.3: KMO and Bartlett's Test.**

KMO Measure of Sampling Adequacy		0.922
	Approx. chi-square	18,591.172
Bartlett's Test of Sphericity	Df	903
	Sig.	.000

If the Kaiser-Meyer-Olkin (KMO) value is less than 0.5, then the factor analysis can be considered inappropriate. However, if the value is 1, or close to 1, then the factor analysis is valid. Table 6.3 shows the current value for KMO as 0.922, which is close to 1 and gives an indication of a strong validity of the sample as well as small correlations among the variables. Thus, it can be seen that this is an appropriate method for factor analysis.

SPSS provides the anti-image correlation matrix, which is the negative value of the partial correlation (shown in Appendix C). The diagonal values contain the measures of sampling adequacy for each variable and the off-diagonal values are partial correlations among the variables. A substantial part of the off-diagonal correlations in the anti-image matrix were less than 0.1, while the diagonal correlations were all more than 0.5. This indicates that

factor analysis was an appropriate technique for summarising the number of items used in this study.

#### 6.4 FINDINGS OF THE CFA

As mentioned in Section 5.3.3.2 of Chapter Five, the second validity of measures will be performed with the help of CFA on the proposed measurement model. The examination performed on the CFA was comprised of sequenced assessments to show the degree of fit with the covariance matrix. SEM CFA was applied to examine the validity of the hypothesised measurement model and both discriminant and convergent validity were evaluated. Alterations of the measurement model were made after the standardised residuals and the modification indices were analysed, as recommended by several researchers (Byrne, 1998; MacCallum, 1986; Segars, 1997). Figure 6.1 shows the initial model prior to the application of the modification indices.

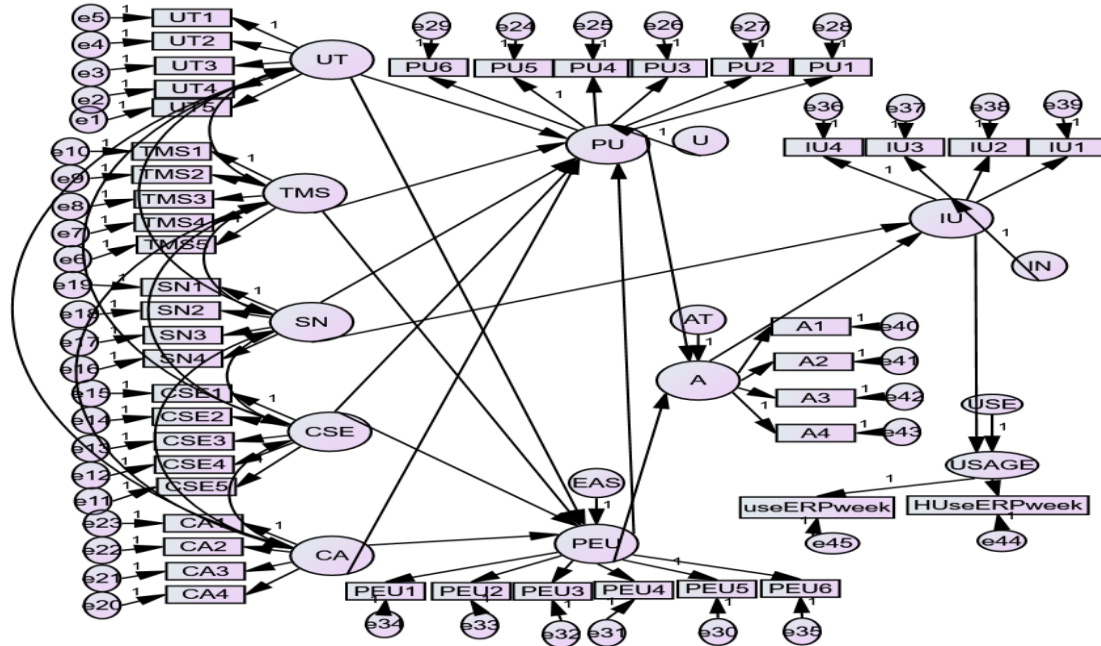


Figure 6.1: Initial Model.

The first attempt to measure the model indicated a poor fit. All recommended cut-off values for the model fit indices (chi-square/df, GFI, NFI, CFI and RMSEA) were below the acceptance levels (Table 6.4). In order to achieve an acceptable model fit, several modifications were performed on items with standardised residuals greater than three on the measurement model, as suggested by the modification indices (see Chapter Five – Section 5.3.3.3). Therefore, 12 of the 45 items from the finalised questionnaire were deleted in order to achieve the recommended cut-off value for model fit indices. Different steps were used when deleting these items. For instance, items with the highest chi-square and factor loadings were deleted first. Moreover, these items were deleted one at a time to make sure that the deletion of each item did not influence another part of the solution, and then the model was re-evaluated after the deletion of each item. Consequently, a new model fit was obtained from these modifications.

The values obtained from the initial model, as illustrated in Table 6.4, show that the AGFI (0.814) was above the recommended threshold value of 0.80 and CFI (0.930) was also above the recommended threshold value of 0.90. However, GFI (0.846) and NFI (0.894) were below the recommended threshold value 0.90. The RMSEA value (0.066) was within the acceptable range (0.03–0.08). The result shows variations between the values obtained from the initial model and the second measure of CFA. For example, it was noticed that the chi-square/df decreases from 5.943 to 439.00. This suggests that potential improvement of the model fit could be achieved by assessing the model fit indices, modification indices and standardised residuals again. Collectively, 18 of the 45 items from the finalised questionnaire were deleted in order to achieve the recommended cut-off value for model fit indices (see Table 6.5 and Table 6.6).

As illustrated in Table 6.4, the ratio chi-square/df decreased from 439.00 (value obtained from second measure) to 2.316 (CFA Model-1), which is within the range recommended by Segars and Grover (1993) with 281 df. AGFI (0.861) was above the recommended threshold value of 0.80. CFI (0.954) and NFI (0.921) were both above 0.90. The RMSEA value for the measurement model was 0.058 with 90% confidence ranging from 0.048 to 0.060, which is within the recommended range of 0.03 to 0.08. However, all values for

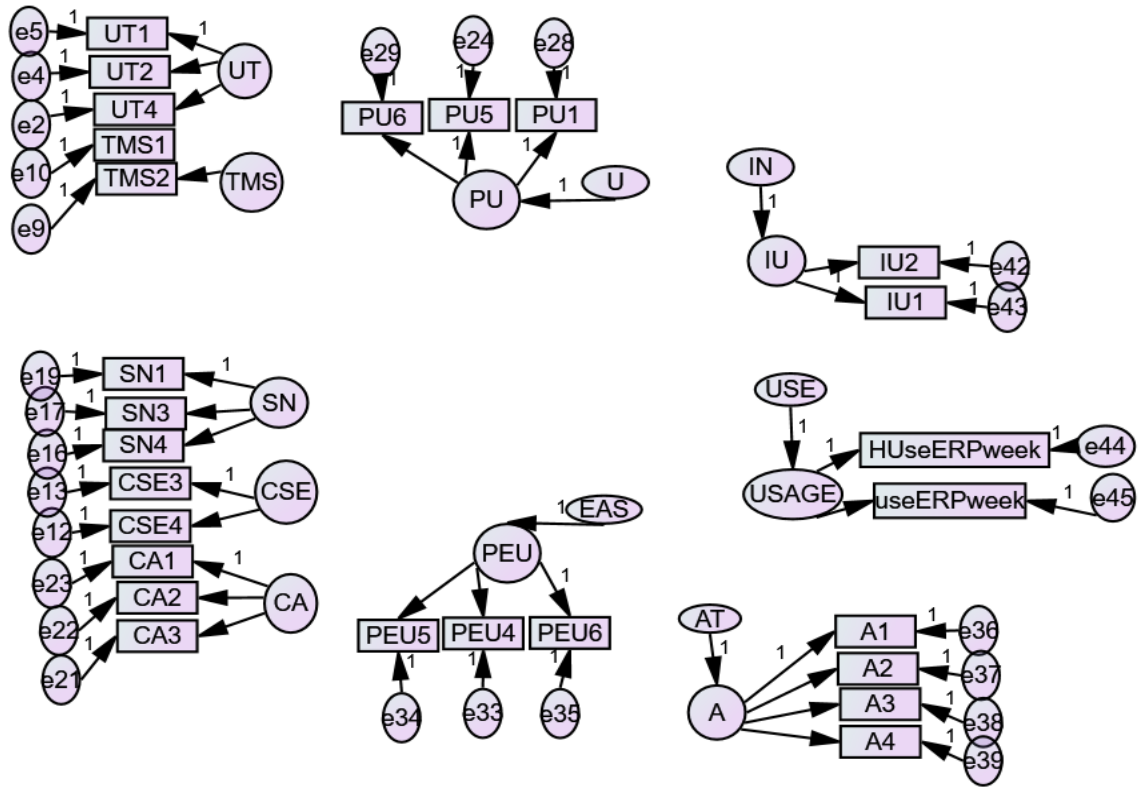


the measurement model indicated acceptable fit to the data except for GFI (0.897), which was slightly lower than the recommended value 0.9; but this was not considered as a reason for rejecting the model's goodness-of-fit. Figure 6.2 shows the measurement model (CFA Model-1).

The measurement model (CFA Model-1) results confirmed that the research participants' responses support the conceptual as well as the theoretical uniqueness of all of the factors (organisational, individual and TAM variables) proposed in this study. Thus, the data seemed appropriate and could be utilised for further analysis.

**Table 6.4: CFA Statistics of Model Fit.**

<b>Goodness-of-fit Measures</b>	<b>Recommended Value</b>	<b>Author(s)</b>	<b>Value Obtained from Initial Model</b>	<b>Value Obtained from Second Measure</b>	<b>CFA Model (Model-1)</b>
Chi-square/df	$\leq 3.00$	Chin and Todd (1995); Kline (1998)	5.943	439.00	2.316
GFI	$\geq 0.90$	Hair et al. (2006)	0.706	0.846	0.897
AGFI	$\geq 0.80$	Segars and Grover (1993)	0.662	0.814	0.861
NFI	$\geq 0.90$	Tate (1998)	0.743	0.894	0.921
CFI	$\geq 0.90$	Kelloway (1998)	0.775	0.930	0.954
RMSEA	0.03–0.08	Hair et al. (2006)	0.112	0.066	0.058



**Figure 6.2: Measurement Model (CFA-Model-1).**

**Table 6.5: Remaining Items After the Modification Indices.**

<b>Factor</b>	<b>Item</b>	<b>Survey Instrument</b>
<b>Perceived Usefulness (PU)</b>	<b>PU1</b>	Using the ERP system would allow me to accomplish my tasks more quickly.
	<b>PU5</b>	Using the ERP would make it easier to do my job.
	<b>PU6</b>	Overall, I find ERP useful in my work.
<b>Perceived Ease of Use (PEU)</b>	<b>PEU4</b>	Getting the information from ERP is easy.
	<b>PEU5</b>	It is easy for me to become skilful at using ERP.
	<b>PEU6</b>	Overall, I find ERP easy to use.
<b>Intention to Use (IU)</b>	<b>IU1</b>	I intend to use the ERP to do my work.
	<b>IU2</b>	I intend to use the ERP in other jobs in the future.
<b>Attitude (A)</b>	<b>A1</b>	Using ERP is a good idea.
	<b>A2</b>	I like the idea of using the ERP system to accomplish my tasks.
	<b>A3</b>	ERP provides a good communication environment.
	<b>A4</b>	I have a positive mindset towards the ERP system.
<b>Usage</b>	<b>Use-ERP/week</b>	How many times do you believe you use the ERP system per week?
	<b>H-Use-ERP/week</b>	How many hours do you believe you use the ERP system per week?
<b>Organisational Factors</b>		
<b>User Training (UT)</b>	<b>UT1</b>	The training provided to me was complete.
	<b>UT2</b>	The training gave me confidence in the system.
	<b>UT4</b>	The training on the operation of the ERP was sufficient.
<b>Top Management Support (TMS)</b>	<b>TMS1</b>	I felt that they supported the system.
	<b>TMS2</b>	I felt that they were had high intentions to change.
<b>Individual Factors</b>		
<b>Computer Anxiety (CA)</b>	<b>CA1</b>	Working with a computer makes me nervous.
	<b>CA2</b>	Computers make me feel uneasy.
	<b>CA3</b>	Computers make me feel uncomfortable.
<b>Subjective Norm (SN)</b>	<b>SN1</b>	My peers believe in the benefits of the ERP.
	<b>SN3</b>	Senior management strongly support my using the ERP system.
	<b>SN4</b>	I would like very much to use the ERP system because senior management think I should use it.
<b>Computer Self-efficacy (CSE)</b>	<b>CSE3</b>	I am confident in using the ERP system even if I have never used it before.
	<b>CSE4</b>	I am confident in using the ERP system as long as someone shows me how to do it.

**Table 6.6: Deleted Items During the Modification Indices.**

<b>Factor</b>	<b>Item</b>	<b>Survey Instrument</b>
<b>Perceived Usefulness (PU)</b>	<b>PU2</b>	Using the ERP would improve my performance
	<b>PU3</b>	Using the ERP would enhance my effectiveness in the work
	<b>PU4</b>	Using the ERP would increase my productivity in the work
<b>Perceived Ease of Use (PEU)</b>	<b>PEU1</b>	Learning to use the ERP is easy for me
	<b>PEU2</b>	Learning to use the ERP is easy for me
	<b>PEU3</b>	I find it easy to get the ERP to do what I want it to do
<b>Intention to Use (IU)</b>	<b>IU3</b>	I intend to increase my use of the ERP in the future
	<b>IU4</b>	Having used the ERP, I would recommend it to my colleagues to use it for work purposes
<b>Usage</b>	<b>Use-ERP/week</b>	How many times do you believe you use the ERP system per week?
	<b>H-Use-ERP/week</b>	How many hours do you believe you use the ERP system per week?
<b>Organisational Factors</b>		
<b>User Training (UT)</b>	<b>UT3</b>	The trainers were knowledgeable and aided me in my understanding of the system
	<b>UT5</b>	Overall, my level of understanding was substantially improved after going through the training programme
<b>Top Management Support (TMS)</b>	<b>TMS3</b>	The company promoted the system before implementation
	<b>TMS4</b>	Our top management supported the ERP implementation project well
	<b>TMS5</b>	The company provided training courses
<b>Individual Factors</b>		
<b>Computer Anxiety (CA)</b>	<b>CA4</b>	Computers scare me
<b>Subjective Norm (SN)</b>	<b>SN2</b>	My management team believes in the benefits of the ERP
<b>Computer Self-efficacy (CSE)</b>	<b>CSE1</b>	I feel comfortable with ERP
	<b>CSE2</b>	I am confident in using the ERP even if there is no one around to show me how to do it
	<b>CSE5</b>	I am confident in using the ERP as long as I have a lot of time to complete the job for which the software is provided

#### 6.4.1 Assessing Reliability and Validity of the Measurement Model

Convergent validity and discriminant validity tests were used to examine the reliability and the validity of the measurement scale. According to the analysis results of Table 6.6, all items of construct loading satisfy the minimum factor-loading value of 0.707 suggested by Gefen et al. (2000) and can be an indicator of convergent validity. In terms of the composite reliability value (CR), each construct's CR was higher than the cut-off value of 0.7 and each construct's AVE was higher than 0.5. The research results indicated that the dimension for the CR value ranged from 0.729 to 0.957. Additionally, the Cronbach's alpha value was greater than the recommended value of 0.7 suggested by Nunnally (1978), indicating a high reliability of the questionnaire. These results indicate that the convergent validity of the questionnaire was satisfied.

**Table 6.6: Reliability and Convergent Validity Tests.**

<b>Factor</b>	<b>Item</b>	<b>Standardised Loadings (&gt; 0.707)<sup>a</sup></b>	<b>AVE (&gt; 0.5)</b>	<b>CR (&gt; 0.7)</b>	<b>Cronbach's Alpha (&gt; 0.7)</b>
<b>IU</b>	IU1	0.851	0.774	0.873	0.871
	IU2	0.908			
<b>UT</b>	UT1	0.854	0.695	0.872	0.869
	UT2	0.903			
	UT4	0.735			
<b>TMS</b>	TMS1	0.823	0.612	0.729	0.743
	TMS2	0.721			
<b>CSE</b>	CSE3	0.805	0.643	0.783	0.783
	CSE4	0.799			
<b>SN</b>	SN1	0.710	0.608	0.820	0.811
	SN3	0.774			
	SN4	0.896			
<b>CA</b>	CA1	0.915	0.880	0.957	0.957
	CA2	0.961			
	CA3	0.938			
<b>PU</b>	PU1	0.803	0.701	0.875	0.873
	PU5	0.885			
	PU6	0.822			
<b>PEU</b>	PEU4	0.852	0.710	0.880	0.880
	PEU5	0.821			
	PEU6	0.854			
<b>A</b>	A1	0.866	0.768	0.930	0.929
	A2	0.896			
	A3	0.858			

	A4	0.885			
	H-Use-ERP/week	0.931			
	Use-ERP/week	0.899			
<b>USAGE</b>			0.837	0.912	0.945

The results of discriminant validity, as shown in Table 6.7, indicate that the ten constructs were unique and distinct constructs. The factor correlation coefficient for all constructs ranged from 0.010 to 0.837, which satisfy the recommended value of  $< 0.85$  suggested by Kline (1998).

**Table 6.7: Factor Correlations.**

	IU	UT	TMS	CSE	SN	CA	PU	PEU	A	USAGE
IU	1									
UT	<b>0.607</b>	1								
TMS	<b>0.487</b>	<b>0.482</b>	1							
CSE	<b>0.695</b>	<b>0.715</b>	<b>0.459</b>	1						
SN	<b>0.474</b>	<b>0.500</b>	<b>0.693</b>	<b>0.491</b>	1					
CA	<b>0.047</b>	<b>0.195</b>	<b>0.065</b>	<b>0.102</b>	<b>0.134</b>	1				
PU	<b>0.784</b>	<b>0.691</b>	<b>0.537</b>	<b>0.705</b>	<b>0.499</b>	<b>0.010</b>	1			
PEU	<b>0.759</b>	<b>0.713</b>	<b>0.535</b>	<b>0.781</b>	<b>0.514</b>	<b>0.055</b>	<b>0.812</b>	1		
A	<b>0.803</b>	<b>0.712</b>	<b>0.512</b>	<b>0.760</b>	<b>0.464</b>	<b>0.015</b>	<b>0.837</b>	<b>0.784</b>	1	
USAGE	<b>0.698</b>	<b>0.443</b>	<b>0.326</b>	<b>0.555</b>	<b>0.341</b>	<b>0.226</b>	<b>0.613</b>	<b>0.558</b>	<b>0.676</b>	1

Note: Factor correlation values less than 0.85 are in bold.

According to Hair et al. (1998), if the value of the square root for the average variance extracted ( $\sqrt{\text{AVE}}$ ) is greater than the  $R^2$  coefficient of the construct it is an indication that discriminant validity is significant. A comparison between values of  $\sqrt{\text{AVE}}$  and  $R^2$  for all constructs was conducted and Table 6.8 shows that the values of  $\sqrt{\text{AVE}}$  for all constructs were greater than  $R^2$ . As a result, all constructs support discriminant validity.

**Table 6.8: Comparison between  $\sqrt{\text{AVE}}$  and  $R^2$ .**

<b>Factor</b>	<b>Item</b>	<b>R<sup>2</sup> coefficients</b>	<b>AVE (&gt; 0.5)</b>	<b><math>\sqrt{\text{AVE}}</math></b>
<b>IU</b>	IU1	<b>0.825</b>	0.774	<b>0.880</b>
	IU2	<b>0.724</b>		
<b>UT</b>	UT1	<b>0.729</b>	0.695	<b>0.834</b>
	UT2	<b>0.816</b>		
	UT4	<b>0.540</b>		
<b>TMS</b>	TMS1	<b>0.560</b>	0.612	<b>0.782</b>
	TMS2	<b>0.577</b>		
<b>CSE</b>	CSE3	<b>0.648</b>	0.643	<b>0.802</b>
	CSE4	<b>0.639</b>		
<b>SN</b>	SN1	<b>0.421</b>	0.608	<b>0.780</b>
	SN3	<b>0.702</b>		
	SN4	<b>0.599</b>		
<b>CA</b>	CA1	<b>0.837</b>	0.880	<b>0.938</b>
	CA2	<b>0.924</b>		
	CA3	<b>0.879</b>		
<b>PU</b>	PU1	<b>0.645</b>	0.701	<b>0.852</b>
	PU5	<b>0.784</b>		
	PU6	<b>0.676</b>		
<b>PEU</b>	PEU4	<b>0.726</b>	0.710	<b>0.842</b>
	PEU5	<b>0.674</b>		
	PEU6	<b>0.730</b>		
<b>A</b>	A1	<b>0.749</b>	0.768	<b>0.876</b>
	A2	<b>0.803</b>		
	A3	<b>0.737</b>		
	A4	<b>0.782</b>		
<b>USAGE</b>	H-Use-ERP/week Use-ERP/week	<b>0.866</b> <b>0.808</b>	0.837	<b>0.915</b>

The correlation matrix for the items is given in Table 6.9. For the sample size of 394 used in the analysis, correlations greater than 0.3 were considered to be statistically significant at the 0.01 level (Robinson et al., 1991; Tabachnick and Fidell, 2007). An inter-item correlations technique was conducted on 27 items using SPSS 20. An inspection of the correlation matrix revealed that all of the inter-item correlations were significant (less than 0.9 and greater than 0.3) at the 0.01 level. The inter-correlations between the items

associated with the measures were stronger than their correlations with items representing other measures. Thus, it can be concluded that the results demonstrated adequate convergent validity as well as discriminant validity. Subsequently, the measurement model was included in further analysis via structural equation modelling (SEM 23), which will be discussed in the next section.



**Table 6.9: Inter-item Correlation Matrix.**

Inter-Item Correlation Matrix																											
	IU1	IU2	UT1	UT2	UT4	TMS 1	TMS 2	CSE 3	CSE4	SN1	SN3	SN4	CA1	CA2	CA3	PU1	PU5	PU6	PEU4	PEU5	PEU6	A1	A2	A3	A4	use ERP /week	H-Use ERP/week
IU1	1.00																										
IU2	<b>0.77</b>	1.00																									
UT1	0.45	0.40	1.00																								
UT2	0.54	0.50	<b>0.76</b>	1.00																							
UT4	0.34	0.32	<b>0.66</b>	<b>0.66</b>	1.00																						
TMS1	0.45	0.42	0.45	0.42	0.37	1.00																					
TMS2	0.20	0.19	0.20	0.22	0.17	0.43	1.00																				
CSE3	0.48	0.48	0.45	0.54	0.41	0.40	0.30	1.00																			
CSE4	0.52	0.49	0.47	0.55	0.38	0.36	0.27	<b>0.64</b>	1.00																		
SN1	0.31	0.32	0.33	0.32	0.36	0.43	0.13	0.38	0.33	1.00																	
SN3	0.38	0.37	0.35	0.36	0.38	0.64	0.24	0.34	0.30	<b>0.59</b>	1.00																
SN4	0.30	0.32	0.35	0.37	0.38	0.54	0.20	0.30	0.34	0.49	<b>0.69</b>	1.00															
CA1	-0.02	0.01	0.19	0.14	0.21	0.07	0.30	0.08	0.13	0.06	0.06	0.30	1.00														
CA2	-0.06	-0.03	0.21	0.11	0.20	0.07	0.27	0.04	0.08	0.13	0.07	0.15	<b>0.88</b>	1.00													
CA3	-0.04	-0.04	0.19	0.12	0.19	0.07	0.26	0.06	0.10	0.17	0.11	0.17	<b>0.86</b>	<b>0.90</b>	1.00												
PU1	0.52	0.48	0.42	0.51	0.33	0.42	0.20	0.45	0.47	0.36	0.35	0.32	0.05	0.01	0.34	1.00											
PU5	0.65	0.59	0.51	0.59	0.38	0.47	0.21	0.47	0.52	0.31	0.36	0.32	0.02	-0.02	-0.01	<b>0.69</b>	1.00										
PU6	0.63	0.55	0.50	0.55	0.38	0.50	0.22	0.46	0.48	0.34	0.39	0.32	-0.04	-0.03	-0.03	<b>0.65</b>	<b>0.75</b>	1.00									
PEU4	0.60	0.48	0.48	0.60	0.38	0.46	0.27	0.54	0.55	0.40	0.37	0.32	0.05	0.03	0.03	0.58	<b>0.66</b>	<b>0.62</b>	1.00								
PEU5	0.60	0.52	0.48	0.55	0.35	0.46	0.27	0.55	0.48	0.35	0.41	0.33	0.02	-0.01	0.03	0.52	0.58	0.56	<b>0.68</b>	1.00							
PEU6	0.62	0.52	0.49	0.57	0.43	0.48	0.26	0.55	0.50	0.35	0.35	0.31	0.11	0.07	0.08	0.50	0.57	0.55	<b>0.73</b>	<b>0.72</b>	1.00						
A1	0.64	0.66	0.49	0.53	0.38	0.41	0.19	0.53	0.50	0.38	0.35	0.26	0.02	0.00	0.00	0.52	0.62	0.63	0.56	0.50	<b>0.54</b>	1.00					
A2	0.63	0.62	0.50	0.59	0.39	0.49	0.26	0.56	0.51	0.35	0.36	0.26	0.02	-0.01	-0.03	0.56	0.66	0.67	0.63	0.57	0.59	<b>0.79</b>	1.00				
A3	0.57	0.58	0.53	0.60	0.41	0.43	0.25	0.53	0.51	0.33	0.34	0.25	0.05	0.02	0.01	0.55	0.63	0.61	0.64	0.52	0.58	<b>0.72</b>	<b>0.81</b>	1.00			
A4	0.66	0.64	0.60	0.62	0.42	0.49	0.25	0.57	0.56	0.34	0.38	0.32	0.05	0.03	0.04	0.61	0.69	0.72	0.63	0.56	0.60	0.77	<b>0.76</b>	<b>0.75</b>	1.00		
use ERP /week	0.56	0.58	0.30	0.38	0.26	0.30	0.08	0.40	0.40	0.22	0.30	0.21	-0.14	-0.22	-0.18	0.42	0.44	0.47	0.41	0.42	0.42	0.58	0.52	0.49	<b>0.52</b>	1.00	
H-Use ERP/week	0.59	0.54	0.31	0.43	0.26	0.31	0.08	0.42	0.41	0.26	0.29	0.18	-0.15	-0.22	-0.20	0.48	0.49	0.53	0.44	0.44	0.44	0.61	0.54	0.52	0.56	<b>0.84</b>	1.00

Note: Inter-item correlations greater than 0.3 are in bold.

## **6.5 STRUCTURAL MODEL ANALYSIS: USING STRUCTURAL EQUATION MODELLING (SEM)**

After the confirmatory techniques were accomplished by the use of CFA, structural model analysis was conducted on the proposed model using structural equation modelling (SEM). Building upon the relationship proposed by Davis et al. (1989), as well as the revised measurement model, the structural model was initiated. Thus, the measurement model was used as the foundation to build the research's structural model by adding the estimated path of the relationships between organisational, individual and TAM variables.

The main objective of SEM in this research study was to examine the underlying hypotheses in order to answer the research question: What are the factors affecting the adoption of ERP systems in HEIs in Saudi Arabia? Causal paths that represent the research's hypotheses were added to the fitting measurement model. The aim of these hypotheses was to determine the relationship between the factors in the structural model.

The TAM (Davis, 1989) posits the beliefs of perceived usefulness (PU) and perceived ease of use (PEOU) as the determinant factors for the intention to use IT, and they mediate the relationship between external factors and behavioural intention to use IT. The IT usage intentions, in turn, directly influenced usages. Therefore, as shown in Figure 6.3, the structural model (full mediation model) suggested that the effects of ERP adoption factors on USAGE of ERP are fully mediated by PEOU and PU. However, alternative computing methods – such as the partial mediation model – were adopted and will be discussed later in Section 6.5.2. Before analysing the structural model, a preliminary data analysis was applied to assess the means and standard deviations for each factor affecting ERP adoption.

### **6.5.1 Factor Means and Standard Deviations**

Table 6.10 presents the analysis that was conducted on ten constructs in the structural model by the use of SPSS 20 in order to calculate the factor means and standard deviations. As shown in Table 6.10, the means for all of the factors ranged from 3.08 to 5.68, indicating “somewhat disagree” to “somewhat agree” levels. The perceived

usefulness of the ERP system had the highest agreement level ( $M = 5.68$ ); whereas, computer anxiety had the lowest agreement level ( $M = 3.08$ ).

**Table 6.10: Factor Means and Standard Deviations.**

<b>Factor</b>	<b>Mean (M)</b>	<b>Standard Deviation (SD)</b>
<b>Perceived Usefulness</b>	5.68	1.28
<b>Perceived Ease of Use</b>	5.47	1.29
<b>Attitude</b>	5.52	1.36
<b>Intention to Use</b>	5.58	1.34
<b>Usage</b>	5.43	1.58
<b>User Training</b>	5.13	1.46
<b>Top Management Support</b>	4.98	1.79
<b>Computer Anxiety</b>	3.08	2.17
<b>Computer Self-efficacy</b>	5.4	1.43
<b>Subjective Norms</b>	5.21	1.55

### **6.5.2 Assessing Structural Model Validity**

In this research, two comparison steps between the CFA model and the SEM models were performed to assess the structural model's validity prior to the path analysis. Loading estimates were performed on the structural model as the first step and the constructs' variations were reported. The reason for using loading estimates was to support the structural model's validity and ensure that factor-loading estimates were unchangeable and consistent for both models.

Table 6.11 shows the existence of slight variations in the loading estimates between the two models (CFA and SEM). For instance, loading estimates for items UT1, UT2, UT4, SN1, SN4, CA1, CA2, PEU5, PEU6, A1, A4 and H-Use-ERP/week in SEM were slightly lower than the loading estimates for CFA's items. However, the maximum variation between the standardised loadings for the models was only 0.007, which was acceptable.

**Table 6.11: CFA and SEM Loading Estimates Comparison.**

<b>Factor</b>	<b>Item</b>	<b>Standardised Loadings for CFA</b>	<b>Standardised Loadings for SEM</b>	<b>Variation</b>
<b>IU</b>	IU1	0.851	0.851	0.000
	IU2	0.908	0.908	0.000
<b>UT</b>	UT1	0.854	0.850	0.001
	UT2	0.903	0.900	0.003
	UT4	0.735	0.728	0.007
<b>TMS</b>	TMS1	0.823	0.823	0.000
	TMS2	0.721	0.721	0.000
<b>CSE</b>	CSE3	0.805	0.805	0.000
	CSE4	0.799	0.799	0.000
<b>SN</b>	SN1	0.710	0.780	0.002
	SN3	0.774	0.774	0.000
	SN4	0.896	0.891	0.001
<b>CA</b>	CA1	0.915	0.910	0.050
	CA2	0.961	0.958	0.050
	CA3	0.938	0.938	0.000
<b>PU</b>	PU1	0.803	0.803	0.000
	PU5	0.885	0.885	0.000
	PU6	0.822	0.822	0.000
<b>PEU</b>	PEU4	0.852	0.852	0.000
	PEU5	0.821	0.818	0.030
	PEU6	0.854	0.850	0.004
<b>A</b>	A1	0.866	0.861	0.050
	A2	0.896	0.896	0.000
	A3	0.858	0.858	0.000
	A4	0.885	0.882	0.003
<b>USAGE</b>	H-Use-ERP/week	0.931	0.97	0.040
	Use-ERP/week	0.899	0.899	0.000

The next step was to examine goodness-of-fit for the structural model. Goodness-of-fit can be achieved for a given model if the indices tests are in the acceptable ranges. The same common indices of fit (GFI, RMSEA, NFI, the model chi-square ( $\chi^2$ ) and CFI) that have been used in examining the goodness-of-fit for the CFA were also applied to the structural model (full mediation model – SEM Model-2). As presented in Table 6.12, the structural model showed an acceptable level of fit to the data (RMSEA = 0.054, chi-square/df = 2.163, NFI = 0.931, GFI = 0.902, AGFI = 0.861 and CFI = 0.954).

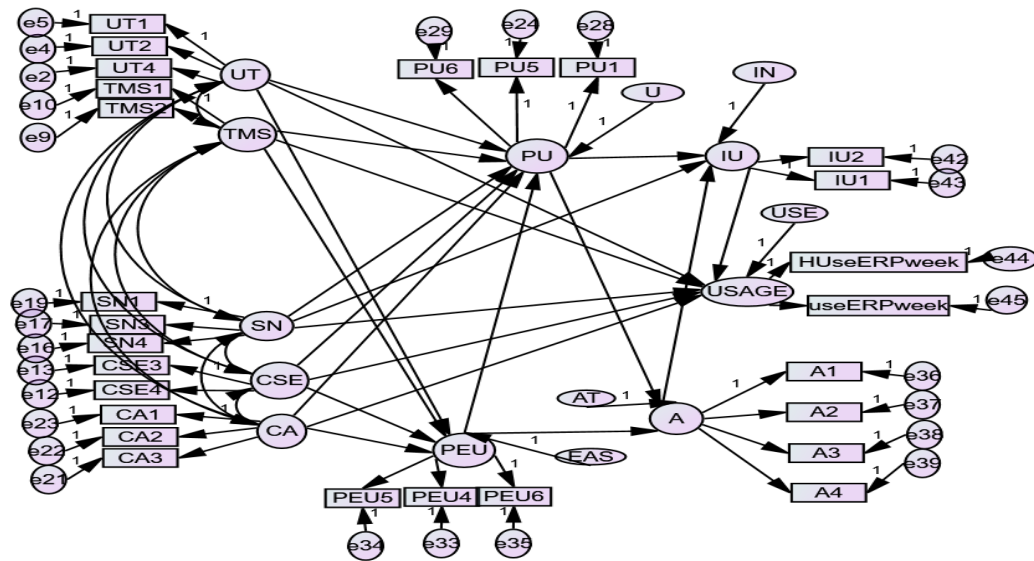


The results showed variations between the values obtained from the structural model (Model-2) and the CFA model (Model-1) in Table 6.4. For example, it was noticed that the chi-square/df decreases from 2.316 to 2.163. This suggests that potential improvement of the model fit can be achieved by assessing other structural paths.

As mentioned earlier in Section 6.4, alternative computing methods – such as the partial mediation model – were adopted to examine the direct and indirect effects of the five external factors (UT, TMS, SN, CSE and CA) on the USAGE of ERP systems. As shown in Figure 6.4, five paths connected the external factors directly with USAGE; although no significant effects (direct and indirect effects) were found from this model. However, the result reveals the existence of an acceptable level of fit for the partial mediation model (Model-3). As presented in Table 6.13, the partial mediation model (Model-3) showed an acceptable level of fit to the data (RMSEA = 0.056, chi-square/df = 2.248, NFI = 0.925, GFI = 0.894, AGFI = 0.864 and CFI = 0.957).

**Table 6.13: SEM Model-3 Statistics of Model Fit.**

<b>Goodness-of-fit Measures</b>	<b>Recommended Value</b>	<b>SEM Model-3 (Partial Mediation)</b>
Chi-square/df	$\leq 3.00$	2.248
GFI	$\geq 0.90$	0.894
AGFI	$\geq 0.80$	0.864
NFI	$\geq 0.90$	0.925
CFI	$\geq 0.90$	0.957
RMSEA	$\leq 0.08$	0.056



**Figure 6.4: Model-3 (Partial Mediation).**

### 6.5.3 The Final Model

All values for the models (Model-1, Model-2 and Model-3) that stem from SEM analysis indicated an acceptable fit to the data and were all found to meet the accepted standards for overall model fit. However, the results showed variations between the values obtained from the models. Such variations in model fit between these models were examined, as illustrated in Table 6.14. This would support the evaluation of whether PEU and PU (employee perception) partially or fully mediated the effect of the external factors (organisational and individual factors) on the usage of ERP systems by HEIs. Table 6.14 shows that the fully mediated model (Model-2) achieves a better fit for the data in all measures (GFI, RMSEA, NFI, the model chi-square ( $\chi^2$ ) and CFI) than the other two models.

**Table 6.14: Comparison of SEM Statistics of Models Fit.**

<b>Goodness-of-fit measures</b>	<b>Recommended Value</b>	<b>Model-1</b>	<b>Model-2 (Full Mediation)</b>	<b>Model-3 (Partial Mediation)</b>
Chi-square/df	$\leq 3.00$	2.316	2.163	2.248
GFI	$\geq 0.90$	0.897	0.902	0.894
AGFI	$\geq 0.80$	0.861	0.868	0.864
NFI	$\geq 0.90$	0.921	0.931	0.925
CFI	$\geq 0.90$	0.954	0.962	0.957
RMSEA	$\leq 0.08$	0.058	0.054	0.056

It can be seen from Table 6.15 that the significant factors have similar results in both models (SEM Model-2 and SEM Model-3). The two models highlight the significant effects of organisational factors (UT and TMS) and the individual factors (CSE, SN and CA) on the PEU and PU of ERP systems. Additionally, the two models highlighted the significant effects of TAM's factors. However, despite the similarity that the both models posit, PEU and PU seem to fit well as mediators between the external factors and ERP USAGE in Model-2. For example, the relationship between CSE and PEU, TMS and PU and CA and PU – with significant effects of 0.001, 0.033 and 0.002, respectively – is better in Model-2 than Model-3. Thus, Model-2 was considered the more appropriate model to be adopted in this research study.

**Table 6.15: Results of SEM Analyses.**

		<b>SEM-Model-2</b>			<b>SEM-Model-3</b>			
<b>Hypothesis</b>	<b>Path</b>	<b>Critical Ratio (C.R.)</b>	<b>Coefficient ( <math>\beta</math> )</b>	<b>p-value</b>	<b>Critical Ratio (C.R.)</b>	<b>Coefficient ( <math>\beta</math> )</b>	<b>p-value</b>	<b>Results (Model -1&amp;2)</b>
<b>H1</b>	UT $\longrightarrow$ PEU	4.048	<b>0.282</b>	<b>0.001</b>	4.024	<b>0.261</b>	<b>0.001</b>	<b>Sig.</b>
<b>H2</b>	TMS $\longrightarrow$ PEU	3.604	<b>0.166</b>	<b>0.001</b>	3.425	<b>0.115</b>	<b>0.001</b>	<b>Sig.</b>
<b>H3</b>	CSE $\longrightarrow$ PEU	6.943	<b>0.522</b>	<b>0.001</b>	6.496	<b>0.424</b>	<b>0.021</b>	<b>Sig.</b>
<b>H4</b>	CA $\longrightarrow$ PEU	-1.668	-0.063	0.095	-1.648	0.034	0.099	Not Sig.



<b>H5</b>	UT → PU	3.241	<b>0.208</b>	<b>0.001</b>	3.23	<b>0.189</b>	<b>0.001</b>	<b>Sig.</b>
<b>H6</b>	TMS → PU	2.133	<b>0.113</b>	<b>0.033</b>	2.094	<b>0.081</b>	<b>0.036</b>	<b>Sig.</b>
<b>H7</b>	SN → PU	0.102	0.006	0.919	0.132	0.008	0.895	Not Sig.
<b>H8</b>	CSE → PU	1.885	<b>0.159</b>	0.059	1.952	<b>0.147</b>	0.051	Not Sig.
<b>H9</b>	CA → PU	-3.136	-0.111	<b>0.002</b>	-3.092	0.059	<b>0.003</b>	<b>Sig.</b>
<b>H10</b>	PEU → PU	5.775	<b>0.486</b>	<b>0.001</b>	5.694	<b>0.47</b>	<b>0.001</b>	<b>Sig.</b>
<b>H11</b>	PU → A	8.453	<b>0.629</b>	<b>0.001</b>	3.888	<b>0.317</b>	<b>0.001</b>	<b>Sig.</b>
<b>H12</b>	PEU → A	4.016	0.288	<b>0.001</b>	8.635	0.742	<b>0.001</b>	<b>Sig.</b>
<b>H13</b>	SN → IU	1.678	0.072	0.093	1.736	0.093	0.083	Not Sig.
<b>H14</b>	A → IU	5.6	<b>0.495</b>	<b>0.001</b>	5.418	<b>0.475</b>	<b>0.001</b>	<b>Sig.</b>
<b>H15</b>	PU → IU	3.818	<b>0.351</b>	<b>0.001</b>	3.554	<b>0.376</b>	<b>0.001</b>	<b>Sig.</b>
<b>H16</b>	IU → USAGE	15.175	<b>0.731</b>	<b>0.001</b>	9.08	<b>0.757</b>	<b>0.001</b>	<b>Sig.</b>

Note: Significant relationships in bold.  $p < 0.05$ ,  $p < 0.01$  [one-tailed test].

#### 6.5.3.1 Path Tests

Path values are statistically significant if the critical ratio or the t-value is greater than 1.96 at 0.05 levels (Hair et al., 2010). For example, referring to Model-2, the first hypothesised path between UT and PEU showed a significant level of 0.001 and a critical ratio of 4.048, which is greater than the threshold value of 1.96. This result indicates that the loading estimates of UT in the prediction of PEU at level  $p < 0.001$  are significantly different from zero. Therefore, this would support the proposed hypotheses relating to the positive effects of UT on PEU. The AMOS outputs (see values for Model-2 in Table 6.15) were utilised to examine the significance of path value. The results revealed that twelve out of sixteen paths were significant, with values exceeding the suggested threshold values of 1.96.

#### 6.5.3.2 Standardised Effects (Direct and Indirect) for the Structural Model

The results of the structural model will not be considered unless the coefficients of determination ( $R^2$ ) and the indirect effects for structural equations are reported in the quantitative model (Schreiber et al., 2006). Schreiber et al. (2006:45) stated that “the relative importance of individual factors and their corresponding effects on one or more outcomes cannot be understood fully unless results have been reported in terms of direct, indirect, and total effects”. According to Cohen (1988) and as cited by Abbad (2013:12), “a standardized path coefficient with an absolute value of less than 0.10

might indicate a small effect, a value around 0.30 a medium one, and a value around 0.50 a large effect”.

The structural model in this research is classified into two categories of constructs: endogenous constructs and exogenous constructs.

### **A. Endogenous Constructs**

- Actual use of ERP systems (USAGE). This construct is an endogenous construct, which consists of two observed indicators/variables, namely Use-ERP/week and H-Use ERP/week.
- Intention to use ERP systems (IU). This construct is an endogenous construct, which consists of two observed indicators/variables, namely IU1 and IU2.
- Attitude towards ERP systems (A). This construct is an endogenous construct, which consists of four observed indicators/variables, namely A1, A2, A3 and A4.
- Perceived ease of use of ERP systems (PEU). This construct is an endogenous construct, which consists of three observed indicators/variables, namely PEU4, PEU5 and PEU6.
- Perceived usefulness of ERP systems (PU). This construct is an endogenous construct, which consists of three observed indicators/variables, namely PU1, PU5 and PU6.

### **B. Exogenous Constructs**

- User training (UT). This construct is an exogenous construct, which consists of three observed indicators/variables, namely UT1, UT2 and UT4.
- Top management support (TMS). This construct is an exogenous construct, which consists of two observed indicators/variables, namely TMS1 and TMS2.
- Subjective norm (SN). This construct is an exogenous construct, which consists of three observed indicators/variables, namely SN1, SN3 and SN4.

- Computer self-efficacy (CSE). This construct is an exogenous construct, which consists of two observed indicators/variables, namely CSE3 and CSE4.
- Computer anxiety (CA). This construct is an exogenous construct, which consists of three observed indicators/variables, namely CA1, CA2 and CA3.

As indicated in Table 6.16, intention to use ERP systems (IU) had the highest direct effect (0.731) and can therefore be considered to be a major determinant of ERP system usage. In terms of total indirect effects on ERP usage, the determinants' of ERP systems usage, in order, were: perceived usefulness (PU), attitude (A), perceived ease of use (PEU), computer self-efficacy (CSE), user training (UT), top management support (TMS), subjective norm (SN) and computer anxiety (CA), with total effects of 0.484, 0.362, 0.339, 0.254, 0.196, 0.111, 0.056 and 0.075, respectively. Furthermore, the results revealed that among all of the exogenous variables, computer self-efficacy (CSE) was the major determinant of ERP usage (0.254).

**Table 6.16: Direct and Indirect Standardised Effects for the Structural Model.**

<b>Factor</b>	<b>Determinant</b>	<b>Direct Effect</b>	<b>Indirect Effect</b>	<b>Total Effect</b>
Perceived Usefulness (PU) ( $R^2 = 0.731$ )	CA	-0.111	-0.031	-0.142
	SN	0.006	-----	0.006
	CSE	<b>0.159</b>	<b>0.253</b>	<b>0.412</b>
	TMS	<b>0.113</b>	0.081	<b>0.194</b>
	UT	<b>0.208</b>	<b>0.137</b>	<b>0.345</b>
	PEU	<b>0.486</b>	-----	<b>0.486</b>
Perceived Ease of Use (PEU) ( $R^2 = 0.704$ )	CA	-0.063	-----	-0.063
	CSE	<b>0.522</b>	-----	<b>0.522</b>
	TMS	<b>0.166</b>	-----	<b>0.166</b>
	UT	<b>0.282</b>	-----	<b>0.282</b>
Attitude (A) ( $R^2 = 0.776$ )	PEU	<b>0.288</b>	<b>0.305</b>	<b>0.594</b>
	PU	<b>0.629</b>	-----	<b>0.629</b>
	CA	-----	-0.108	-0.108
	SN	-----	0.004	0.004
	CSE	-----	<b>0.410</b>	<b>0.410</b>
	TMS	-----	<b>0.170</b>	<b>0.170</b>
	UT	-----	<b>0.298</b>	<b>0.298</b>

Intention to Use (IU) ( $R^2 = 0.732$ )	SN	0.072	0.004	0.076
	PU	<b>0.351</b>	<b>0.311</b>	<b>0.662</b>
	A	<b>0.495</b>	-----	<b>0.495</b>
	PEU	-----	<b>0.464</b>	<b>0.464</b>
	CA	-----	-0.103	-0.103
	CSE	-----	<b>0.347</b>	<b>0.347</b>
	TMS	-----	<b>0.152</b>	<b>0.152</b>
	UT	-----	<b>0.269</b>	<b>0.269</b>
	Usage	-----	-----	-----
Usage ( $R^2 = 0.534$ )	IU	<b>0.731</b>	-----	<b>0.731</b>
	SN	-----	0.056	0.056
	PU	-----	<b>0.484</b>	<b>0.484</b>
	A	-----	<b>0.362</b>	<b>0.362</b>
	PEU	-----	<b>0.339</b>	<b>0.339</b>
	CA	-----	-0.075	-0.075
	CSE	-----	<b>0.254</b>	<b>0.254</b>
	TMS	-----	<b>0.111</b>	<b>0.111</b>
	UT	-----	<b>0.196</b>	<b>0.196</b>

Note: Effects greater than 0.1 in bold.

The predictive power for the structural model was elucidated by variance explained ( $R^2$ ) of the endogenous constructs. The findings confirmed that the structural model explains a great proportion of the variance in the endogenous variables. As illustrated in Table 6.16 above, the structural model resulted in 73.1% for the perceived usefulness of ERP (due to direct and indirect effects), 70.4% for the perceived ease of use of ERP (due to indirect effects), 77.6% for attitude towards ERP systems (due to direct and indirect effects), 73.2% for intention to use ERP systems (due to direct and indirect effects) and 53.4% for usage of ERP systems (due to direct and indirect effects), providing satisfactory explanatory power. The average variance explained ( $R^2$ ) by the model was 69.5%.

## 6.6 HYPOTHESES TESTING

Table 6.15 illustrates the examination of the sixteen hypothesised relationships (H1–H16) in the structural model, as well as the support of such hypotheses related to the proposed model. The results from Table 6.15 and Table 6.16 were used to explain the significance of the hypothesised relationships in the structural model. The implications of these research results will be discussed in the next chapter (Chapter Seven).

## **6.6.1 Effects of Organisational Factors on ERP Systems**

### **6.6.1.1 User Training (UT)**

Based on the results of the AMOS analysis (and as outlined in Table 6.16), Hypothesis 1 (H1) found that UT had a positive influence on the PEU of ERP systems. This suggests that UT has a significant impact with a direct effect on the PEU of ERP systems ( $\beta = 0.282$ ,  $p < 0.05$ ). Moreover, the critical ratio/t-value of 4.048 exceeded the recommended threshold of 1.96, with a significance level of less than 0.05.

In terms of Hypothesis 5 (H5), UT was found to have a positive influence on the PU of ERP systems. This suggests that UT has a significant impact with a direct effect on the PU of ERP systems ( $\beta = 0.208$ ,  $p < 0.05$ ). Moreover, the critical ratio/t-value of 3.241 exceeded the recommended threshold of 1.96, with a significance level of less than 0.05.

### **6.6.1.2 Top Management Support (TMS)**

In Hypothesis 2 (H2), TMS was found to have a positive influence on PEU of ERP systems. This suggests that TMS has a significant impact with a direct effect on PEU of ERP systems ( $\beta = 0.166$ ,  $p < 0.05$ ). Moreover, the critical ratio/t-value of 3.604 exceeded the recommended threshold of 1.96, with a significance level of less than 0.05.

In terms Hypothesis 6 (H6), TMS was found to have a positive influence on the PU of ERP systems. This suggests that TMS has a significant impact with a direct effect on the PU of ERP systems ( $\beta = 0.113$ ,  $p < 0.05$ ). Moreover, the critical ratio/t-value of 2.133 exceeded the recommended threshold of 1.96, with a significance level of less than 0.05.

## **6.6.2 Effects of Individual Factors on ERP Systems**

### **6.6.2.1 Computer Self-efficacy (CSE)**

Hypothesis 3 (H3) found that CSE had a positive influence on the PEU of ERP systems. This suggests that CSE has a significant impact with a direct effect on the PEU of ERP systems ( $\beta = 0.522$ ,  $p < 0.05$ ). Moreover, the critical ratio/t-value of 6.943

exceeded the recommended threshold of 1.96, with a significance level of less than 0.05; therefore, H3 was supported.

Hypothesis 8 (H8) stated that CSE would have a positive influence on the PU of ERP systems. However, H8 was not positively related to the PU of ERP systems ( $\beta = 0.159$ ,  $p = 0.059$ ). Furthermore, the critical ratio/t-value of 1.885 was less than the recommended threshold of 1.96. Thus, the hypothesis was rejected.

#### **6.6.2.2 Computer Anxiety (CA)**

Hypothesis 4 (H4) suggested that CA will have a direct and negative effect on the PEU of ERP systems. However, CA was not positively related to the PEU of ERP systems ( $\beta = -0.063$ ,  $p = 0.095$ ). Furthermore, the critical ratio/t-value of -1.668 was less than the recommended threshold of 1.96. Thus, the hypothesis was rejected.

In terms of Hypothesis 9 (H9), CA had a negative influence on the PU of ERP systems ( $\beta = -0.111$ ,  $p = 0.002$ ). In addition, the critical ratio/t-value of -3.136 exceeded the recommended threshold of 1.96, with significance levels of less than 0.05.

#### **6.6.2.3 Subjective Norms (SN)**

Hypothesis 7 (H7) stated that SN has a positive influence on the PU of ERP systems. However, SN was not found to be positively related to the PU of ERP systems ( $\beta = 0.006$ ,  $p = 0.919$ ) and the critical ratio/t-value of 0.102 was less than the recommended threshold of 1.96. Thus, the hypothesis was rejected.

In terms of IU, Hypothesis 13 (H13) suggested that SN would have a significant impact with a direct effect on the IU of the ERP system. The results showed that SN was not positively related to the IU of the ERP system ( $\beta = 0.072$ ,  $p = 0.093$ ) and the critical ratio/t-value of 1.678 was less than the recommended threshold of 1.96. Thus, the hypothesis was also rejected.

#### **6.6.3 The Relationships Between TAM Factors**

Hypothesis 10 (H10) stated that PEU would have a positive influence on the PU of the ERP system. The results indicated that PEU had a strong and direct effect on the PU

of the ERP system ( $\beta = 0.486$ ,  $p < 0.05$ ). In addition, the critical ratio/t-value of 5.775 exceeded the recommended threshold of 1.96, with significance levels of less than 0.05. Thus, the hypothesis was supported.

Hypotheses 11 and 12 (H11 and H12) postulated that the PU and PEU would have positive influences on users' attitude (A) towards the ERP system. The results indicated that PU and PEU have a strong and direct effect on A ( $\beta = 0.629$  and  $0.288$ , respectively;  $p < 0.05$ ). The respective critical ratios/t-values of 8.453 (H11) and 4.016 (H12) were greater than the critical value of 1.96, with significance levels of less than 0.05. The findings confirm that both PU and PEU have a strong influence on A towards ERP systems. Therefore, both the H11 and H12 hypotheses are supported.

Hypotheses 14 and 15 (H14 and H15) examine the relationship of the IU of the ERP system with PU and A. These hypotheses suggest that PU and A would have significant impact with a direct effect on the IU of the ERP systems. The results confirm that IU has a strong and direct effect on PU and A ( $\beta = 0.351$  and  $0.495$ , respectively;  $p < 0.05$ ). The respective critical ratios/t-values of 3.818 (H14) and 5.600 (H15) were greater than the critical value of 1.96, with significance levels of less than 0.05. Thus, both the H14 and H15 hypotheses are supported.

The results of this study support the H16 hypothesis (IU), which focuses on the impact of users' intentions on the actual use of the ERP system. H16 suggests that the IU of the ERP system would have a significant impact with direct effects on ERP usage ( $\beta = 0.731$ ,  $p < 0.05$ ). The critical ratio/t-value of 15.175 was greater than the critical value of 1.96, with significance levels of less than 0.05. Thus, the hypothesis is supported.

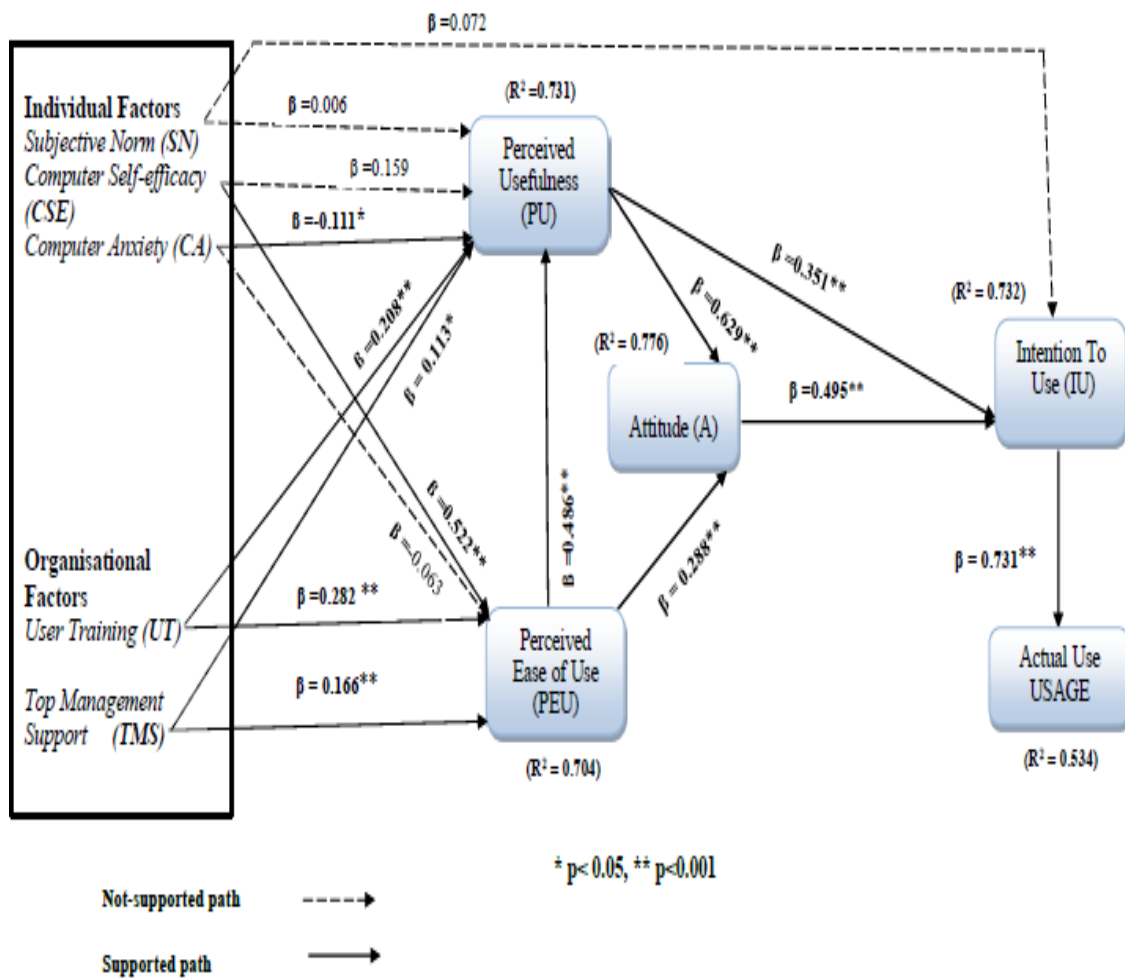
#### **6.6.4 Conclusion**

Overall, the results of this study have confirmed that organisational factors have a significant effect on users' PEU and PU of the ERP system (H1, H5, H2 and H6). Of the three individual variables, on the other hand, only CSE was found to have a strong positive influence with a direct effect on the PEU of the ERP system. CA was found to have a negative influence with a direct effect on the PU of the ERP system (both

H3 and H9 were supported). SN had no effect on users' PU or IU (H7 and H13 were not supported). PEU had a significant effect on PU, and both PEU and PU affect users' A towards IU (H10, H11 and H12 were supported). In addition, in terms of IU, the results show that PU and A towards the ERP systems are the dominant factors affecting users' IU of the ERP system (H14 and H15 were supported). Finally, IU had a significant and direct effect on the USAGE of the ERP system (H16 was supported) and no other significant effects were found.

In summary, H1, H2, H3, H5, H6, H9, H10, H11, H12, H14, H15 and H16 were supported; whereas, H4, H7, H8 and H13 were not supported. Figure 6.5, therefore, shows the final research model. Table 6.17 shows the summary of the research hypotheses and it indicates whether the research findings support or do not support the hypotheses.





**Figure 6.5: Final Model.**

**Table 6.17: A Summary of the Research Hypotheses.**

Hypothesis	Result
H1: User training (UT) will have a direct and positive effect on the perceived ease of use (PEU) of ERP systems.	<b>Supported</b>
H2: Top management support (TMS) will have a direct and positive effect on the perceived ease of use (PEU) of ERP systems.	<b>Supported</b>
H3: Computer self-efficacy (CSE) will have a direct and positive effect on the perceived ease of use (PEU) of ERP systems.	<b>Supported</b>

H4: Computer anxiety (CA) will have a direct and negative effect on the perceived ease of use (PEU) of ERP systems.	<b>Not Supported</b>
H5: User training (UT) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.	<b>Supported</b>
H6: Top management support (TMS) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.	<b>Supported</b>
H7: Subjective norm (SN) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.	<b>Not Supported</b>
H8: Computer self-efficacy (CSE) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.	<b>Not Supported</b>
H9: Computer anxiety (CA) will have a direct and negative effect on the perceived usefulness (PU) of ERP systems.	<b>Supported</b>
H10: Perceived ease of use (PEU) will have a direct and positive effect on the perceived usefulness (PU) of ERP systems.	<b>Supported</b>
H11: Perceived usefulness (PU) will have a direct and positive effect on the attitude (A) to use ERP systems.	<b>Supported</b>
H12: Perceived ease of use (PEU) will have a direct and positive effect on the attitude (A) to use ERP systems.	<b>Supported</b>
H13: Subjective norms (SN) will have a direct and positive effect on the intention to use (IU) ERP systems.	<b>Not Supported</b>
H14: Perceived usefulness (PU) will have a direct and positive effect on the intention to use (IU) ERP systems.	<b>Supported</b>
H15: Attitude (A) will have a direct and positive effect on the intention to use (IU) ERP systems.	<b>Supported</b>
H16: Intention to use (IU) will have a positive effect on the actual use (USAGE) of ERP systems.	<b>Supported</b>

## 6.7 THE INFLUENCE OF DEMOGRAPHIC DIFFERENCES ON THE STUDY'S FACTORS (ANOVA)

Analysis of variances (ANOVA) is one of the statistical techniques that have been used to test differences in means between two or more groups. Hair et al. (2010:440) define ANOVA as a “statistical technique used to determine whether samples from two or more groups come from populations with equal means (i.e., Do the group means differ significantly?)”. Such technique utilises the F ratio to examine the overall fit of a model (Field, 2009). Therefore, to examine the influence of the research demographic (gender, experience, department, education, age, place of residence and marital status) on the study's factors (perceived usefulness, perceived ease of use, attitude, intention to use, usage, top management support, user training, subjective norms, computer anxiety and computer self-efficacy), a series of one-way ANOVA were conducted using SPSS 20.

### 6.7.1 Gender – Descriptive Statistics and One-way ANOVA Results

The effects of employees' gender upon perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

As represented in Table 6.18, male employees had higher mean scores than female employees in all factors except for IU and CA. Using a significance level of 0.05, significant gender differences were found for TMS and CSE. The table shows that the male's rating of TMS ( $M = 5.07$ ) was higher than the female's rating ( $M = 4.81$ ;  $F = 3.836$ ,  $p = 0.051$ ). In terms of CSE, the male's mean rating of 5.51 was higher than the female's mean rating of 5.21 ( $F = 5.344$ ,  $p = 0.021$ ).

**Table 6.18: Gender – Descriptive Statistics and One-way ANOVA Results.**

Factor	Male (n = 248)		Female (n = 146)		F Test	
	Mean	SD	Mean	SD	F Ratio	F Sig.
PU	5.70	1.126	5.64	1.158	0.280	0.597

<b>PEU</b>	5.54	1.138	5.37	1.086	2.120	0.146
<b>A</b>	5.57	1.183	5.42	1.319	1.390	0.239
<b>IU</b>	5.59	1.178	5.60	1.223	0.004	0.949
<b>USAGE</b>	5.45	1.476	5.39	1.599	0.135	0.713
<b>UT</b>	5.14	1.278	5.04	1.283	0.583	0.446
<b>TMS</b>	5.07	1.203	4.81	1.340	3.836	<b>0.051</b>
<b>SN</b>	5.27	1.253	5.11	1.425	1.488	0.223
<b>CA</b>	3.05	2.032	3.17	2.070	0.322	0.571
<b>CSE</b>	5.51	1.125	5.21	1.344	5.344	<b>0.021</b>

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

### 6.7.2 Experiences – Descriptive Statistics and One-way ANOVA Results

The effects of users' experience on perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

Experience levels ranged from less than one year to more than six years in the research sample. As represented in Table 6.19, ERP users with less than one year of ERP experience had higher mean scores than the other user experience categories (except for the TMS and USAGE factors). Using a significance level of 0.05, significant experience differences were found for CA. The table shows that ERP users with less than one year of experience had higher mean scores for CA ( $M = 4.15$ ) than other user experience categories ( $F = 9.961$ ,  $p < 0.05$ ). No other statistically significant differences were found for the user experience ranges.

**Table 6.19: Experiences – Descriptive Statistics and One-way ANOVA Testing Results.**

Factor	Less than 1 year (n = 51)		1–3 years (n = 63)		3–6 years (n = 113)		More than 6 years (n = 167)		F Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F Ratio	F Sig.
<b>PU</b>	5.78	1.127	5.60	1.198	5.75	1.129	5.62	1.126	0.548	0.650
<b>PEU</b>	5.56	1.039	5.50	1.023	5.48	1.174	5.43	1.150	0.202	0.895
<b>A</b>	5.76	1.115	5.30	1.203	5.46	1.422	5.56	1.139	1.440	0.231
<b>IU</b>	5.57	1.145	5.51	1.103	5.53	1.294	5.67	1.174	0.436	0.728
<b>USAGE</b>	5.45	1.470	5.26	1.598	5.39	1.467	5.51	1.550	0.423	0.736
<b>UT</b>	5.40	1.317	5.02	1.151	5.06	1.289	5.08	1.305	1.046	0.372
<b>TMS</b>	4.81	1.221	4.69	1.200	5.09	1.386	5.05	1.191	1.934	0.123
<b>SN</b>	5.52	1.239	5.19	1.158	5.13	1.399	5.18	1.344	1.128	0.338
<b>CA</b>	4.15	2.280	3.76	2.027	2.76	1.928	2.74	1.893	9.961	<b>0.000</b>
<b>CSE</b>	5.60	1.162	5.32	1.194	5.29	1.322	5.44	1.169	0.905	0.438

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

### 6.7.3 Department – Descriptive Statistics and One-way ANOVA Results

The effects of department on perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

Department categories in the research sample were: (1) finance department, (2) registration department, (3) HR department and (4) other departments. As shown in Table 6.20, the finance department had the highest mean score ( $M = 5.88$ ) among all departments in all factors except for USAGE, TMS, CA and CSE. Using a significance level of 0.05, significant department differences were found for CA. Table 6.20 shows

that the registration department rating for CA ( $M = 3.92$ ) was higher than other department categories ( $F = 4.355$ ,  $p < 0.05$ ). No other statistically significant differences were found for department.

**Table 6.20: Department – Descriptive Statistics and One-way ANOVA Testing Results.**

Factor	Finance Department (n = 93)		Registration Department (n = 113)		HR Department (n = 102)		Other Departments (n = 86)		F Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F Ratio	F Sig.
<b>PU</b>	5.88	1.089	5.57	1.134	5.57	1.231	5.72	1.057	1.738	0.159
<b>PEU</b>	5.70	1.057	5.40	1.160	5.36	1.218	5.47	0.993	1.724	0.161
<b>A</b>	5.61	1.229	5.48	1.191	5.45	1.295	5.53	1.244	0.295	0.829
<b>IU</b>	5.79	1.075	5.55	1.150	5.39	1.301	5.69	1.215	2.080	0.102
<b>USAGE</b>	5.39	1.745	5.43	1.466	5.22	1.503	5.73	1.318	1.807	0.145
<b>UT</b>	5.36	1.170	4.98	1.345	5.08	1.223	5.04	1.350	1.674	0.172
<b>TMS</b>	4.83	1.310	4.91	1.239	5.00	1.291	5.19	1.186	1.322	0.267
<b>SN</b>	5.35	1.392	5.18	1.199	5.10	1.360	5.24	1.353	0.607	0.611
<b>CA</b>	3.91	2.173	3.92	1.829	2.91	1.873	1.35	0.945	4.355	<b>0.000</b>
<b>CSE</b>	5.48	1.194	5.31	1.256	5.34	1.181	5.49	1.244	0.531	0.661

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

#### 6.7.4 Education – Descriptive Statistics and One-way ANOVA Results

The effects of users' educational levels on perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

Educational levels for ERP users in the research sample ranged from high school or less through to Masters or PhD degrees. As presented in Table 6.21, ERP users who hold a Masters or PhD degree had higher means scores ( $M = 5.98$ ) in all factors than all users who hold other types of degrees, except for UT, SN, CA and CSE. Significant educational differences were found for the majority of the factors (PU, A, IU, USAGE, UT, TMS and CA), except for PEU and CSE. Using a significance level of 0.01, the table shows that users' who hold a Masters or PhD degree had ratings for the IU of ERP systems ( $M = 5.88$ ) that were higher than users in other education categories ( $F = 3.982$ ,  $p = 0.008$ ).

Using a significance of 0.05, the results indicated that users who hold a Masters or PhD degree had higher ratings of attitude (A) towards ERP systems ( $M = 5.89$ ) than users in other the educational categories ( $F = 3.525$ ,  $p = 0.015$ ). Masters or PhD degree qualified users had a significantly higher intention to use ERP systems ( $M = 5.88$ ) than users in the other educational categories ( $F = 3.982$ ,  $p = 0.008$ ). They also had a significantly higher usage of ERP systems ( $M = 5.81$ ) than users in the other educational categories ( $F = 2.883$ ,  $p = 0.036$ ) and a significantly higher TMS ( $M = 5.28$ ) than users in the other educational categories ( $F = 3.667$ ,  $p = 0.012$ ). However, users who hold university degrees had a significantly higher ERP training ( $M = 5.30$ ) than users in the other educational categories ( $F = 5.30$ ,  $p = 0.019$ ).

Finally, users who hold a high school or less education had a significantly higher CA ( $M = 3.53$ ) than users in the other educational categories ( $F = 3.774$ ,  $p = 0.011$ ). No other statistically significant differences were found for education.

**Table 6.21: Education – Descriptive Statistics and One-way ANOVA Testing Results.**

Factor	High School or Less (n = 55)		Diploma (n = 105)		University Degree (BA) (n = 190)		Masters or PhD (n = 44)		F Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F Ratio	F Sig.
PU	5.58	1.479	5.48	1.094	5.74	1.047	5.98	1.064	2.462	0.062

<b>PEU</b>	5.51	1.370	5.27	1.110	5.60	0.976	5.39	1.331	2.058	0.105
<b>A</b>	5.55	1.390	5.23	1.298	5.58	1.157	5.89	1.097	3.525	<b>0.015</b>
<b>IU</b>	5.34	1.502	5.36	1.146	5.73	1.070	5.88	1.260	3.982	<b>0.008</b>
<b>USAGE</b>	5.14	1.752	5.20	1.494	5.55	1.472	5.81	1.381	2.883	<b>0.036</b>
<b>UT</b>	4.97	1.498	4.83	1.247	5.30	1.137	5.10	1.520	3.362	<b>0.019</b>
<b>TMS</b>	4.87	1.518	4.68	1.277	5.10	1.143	5.28	1.239	3.667	<b>0.012</b>
<b>SN</b>	5.04	1.585	4.98	1.278	5.36	1.222	5.34	1.410	2.300	0.077
<b>CA</b>	3.53	2.117	3.41	2.061	2.96	1.994	2.38	1.936	3.774	<b>0.011</b>
<b>CSE</b>	5.40	1.434	5.21	1.209	5.50	1.125	5.40	1.315	1.336	0.262

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

#### 6.7.5 Age – Descriptive Statistics and One-way ANOVA Results

The effects of age on perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

The age categories in the research sample were: (1) under 20 years, (2) 20–29 years, (3) 30–39 years and (4) 40 years and above. For the analysis, Category 1 (with 20 respondents) and Category 4 (with 59 respondents) were merged with Categories 2 and 3, respectively. Thus creating two age groups: under 30 years and 30 years and above.

As presented in Table 6.22, ERP users who were under 30 years old had higher mean scores ( $M = 5.98$ ) than users who were 30 years old or above in all factors except for ERP USAGE and TMS. Using a significance of 0.05, significant age differences were found for TMS and CA. Table 6.22 reveals that users who were 30 years old and above had higher TMS ratings ( $M = 5.09$ ) than those who were under 30 years old ( $M = 4.84$ ;  $F = 1.249$ ,  $p = 0.047$ ). On the other hand, users who were under 30 years old had higher



CA ratings ( $M = 3.50$ ) than those who were 30 years old and above ( $M = 2.75$ ;  $F = 13.367$ ,  $p = 0.000$ ).

**Table 6.22: Age – Descriptive Statistics and One-way ANOVA Results.**

Factor	Under 30 years (n = 180)		30 years and above (n = 214)		F Test	
	Mean	SD	Mean	SD	F Ratio	F Sig.
PU	5.72	1.148	5.63	1.128	0.599	0.439
PEU	5.54	1.118	5.42	1.122	1.191	0.276
A	5.58	1.255	5.46	1.220	0.787	0.376
IU	5.64	1.106	5.55	1.263	0.536	0.465
USAGE	5.39	1.575	5.46	1.477	0.193	0.660
UT	5.14	1.307	5.08	1.258	0.215	0.643
TMS	4.84	1.262	5.09	1.249	3.966	<b>0.047</b>
SN	5.27	1.324	5.17	1.318	0.550	0.459
CA	3.50	2.195	2.75	1.847	13.367	<b>0.000</b>
CSE	5.41	1.220	5.39	1.218	0.041	0.839

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

#### 6.7.6 Place of Residence – Descriptive Statistics and One-way ANOVA Results

The effects of users' place of residence on perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

As presented in Table 6.23, users who live in Riyadh (the capital of Saudi Arabia) had higher mean scores than those who live in other cities in all factors except for CA. Significant place of residence differences were found for the majority of the factors, except for UT, TMS and SN. Using a significance level of 0.05, Table 6.23 shows that

the ratings of all factors for users who live in Riyadh were significantly higher than those who live in other cities, except for CA. Users who live in Jeddah had higher ratings of CA ( $M = 3.50$ ) than those living in other cities ( $F = 13.367$ ,  $p = 0.000$ ).

**Table 6.23: Place of Residence – Descriptive Statistics and One-way ANOVA Results.**

Factor	Riyadh (n = 158)		Jeddah (n = 25)		Dammam (n = 55)		Other (n = 156)		F Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F Ratio	F Sig.
<b>PU</b>	5.99	1.135	4.99	1.133	5.46	1.127	5.54	1.058	8.869	<b>0.000</b>
<b>PEU</b>	5.67	1.224	5.16	0.935	5.20	1.161	5.42	0.987	3.644	<b>0.013</b>
<b>A</b>	5.84	1.235	4.88	1.013	5.21	1.268	5.40	1.177	7.861	<b>0.000</b>
<b>IU</b>	5.80	1.249	5.11	1.004	5.48	1.189	5.51	1.135	3.375	<b>0.018</b>
<b>USAGE</b>	5.70	1.568	5.04	1.306	5.40	1.299	5.23	1.545	3.129	<b>0.026</b>
<b>UT</b>	5.20	1.387	4.88	1.031	5.00	1.115	5.08	1.256	0.714	0.544
<b>TMS</b>	5.08	1.310	4.46	1.132	4.95	1.329	4.96	1.192	1.773	0.152
<b>SN</b>	5.31	1.470	4.97	1.080	4.98	1.234	5.24	1.216	1.160	0.325
<b>CA</b>	2.87	2.179	4.03	1.778	3.70	1.892	2.96	1.927	4.342	<b>0.005</b>
<b>CSE</b>	5.67	1.212	5.03	1.189	5.19	1.287	5.26	1.159	4.690	<b>0.003</b>

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

#### **6.7.7 Marital Status – Descriptive Statistics and One-way ANOVA Results**

The effects of users' marital status on perceived usefulness (PU), perceived ease of use (PEU), attitude (A), intention to use (IU), usage (USAGE), top management support (TMS), user training (UT), subjective norms (SN), computer anxiety (CA) and computer self-efficacy (CSE) were examined using one-way ANOVA.

As presented in Table 6.24, users who were single had higher mean scores than users in other status categories in all factors except for A, TMS, SN and CA. Using a

significance level of 0.05, a significant difference was identified for the marital status category and SN. The table shows that users who were single had higher ratings for SN ( $M = 5.40$ ) than the users in other marital status categories ( $F = 3.202$ ,  $p = 0.042$ ).

**Table 6.24: Marital Status – Descriptive Statistics and One-way ANOVA Results.**

Factor	Single (n = 160)		Married (n = 223)		Other (n = 11)		F Test	
	Mean	SD	Mean	SD	Mean	SD	F Ratio	F Sig.
<b>PU</b>	5.76	1.081	5.64	1.165	5.16	1.297	1.632	0.197
<b>PEU</b>	5.53	1.123	5.46	1.117	4.99	1.130	1.224	0.295
<b>A</b>	5.53	1.269	5.54	1.212	4.81	1.118	1.833	0.161
<b>IU</b>	5.62	1.130	5.60	1.231	5.07	1.299	1.116	0.329
<b>USAGE</b>	5.45	1.439	5.42	1.587	5.31	1.436	0.061	0.941
<b>UT</b>	5.15	1.295	5.08	1.271	4.90	1.285	0.274	0.761
<b>TMS</b>	4.90	1.285	5.04	1.253	4.85	1.047	0.617	0.540
<b>SN</b>	5.40	1.254	5.10	1.368	4.70	0.927	3.202	<b>0.042</b>
<b>CA</b>	3.12	2.087	3.05	2.008	3.56	2.302	0.342	0.710
<b>CSE</b>	5.41	1.251	5.41	1.199	4.96	1.109	0.736	0.480

Note:  $p < 0.05$ ,  $p < 0.01$ . Source: Analysis of the Survey Data.

## 6.8 SUMMARY

This chapter has introduced the different statistical techniques used to investigate the factors that may lead HEIs to adopt ERP systems. The results showed that the external factors (both individual and organisational) that are discussed in Chapter Three could be used in the proposed model. CFA was performed on the hypothesised measurement model. Then, after determining the best-fitting measurement model, convergent and discriminant validity were assessed. All of the results indicated evidence of strong convergent validity for the research factors of the measurement model.

The proposed structural model was revised and examined using SEM techniques and then the proposed hypotheses were tested. A series of one-way ANOVA tests using SPSS 20 were conducted to examine the influence of the research demographic (gender, experience, department, education, age, place of residence and marital status) on the study's factors (perceived usefulness, perceived ease of use, attitude, intention to use, usage, top management support, user training, subjective norms, computer anxiety and computer self-efficacy).

## **CHAPTER SEVEN: RESEARCH SUMMARY AND CONCLUSIONS**

### **7.1 INTRODUCTION**

The aim of this research was to investigate and identify the main factors affecting the adoption of ERP systems in the higher education institutions (HEIs) of Saudi Arabia. ERP adoption was studied from the acceptance of information systems point of view. The technology acceptance model (TAM) was utilised to achieve this aim and, thus, an extended version of TAM was developed in this research to investigate the factors that affect the adoption of ERP systems in Saudi Arabia's HEIs.

This chapter is dedicated to draw conclusions from the study's findings, providing an understanding of the main factors affecting the adoption of ERP systems in Saudi Arabia's HEIs. It begins by summarising and linking the findings of this research with the study objectives. Then the chapter presents the implications and contributions of the research to the existing knowledge. The main limitations of the research are also discussed, followed by some recommendations for future research.

This research has four objectives. The first was to investigate the current usage of ERP systems in HEIs in Saudi Arabia. As such, an extensive search of the literature was conducted to locate the studies related to ERP systems in HEIs, particularly those located in Saudi Arabia. The second objective was to examine various technology adoption frameworks for the implementation of ERP in HEIs. To achieve this aim, four well-known technology acceptance models were discussed and critiqued. The third objective was to identify the factors affecting the adoption of ERP systems in HEIs in Saudi Arabia and to develop a theoretical model for ERP adoption. Based on the literature review of ERP systems and the TAM model, the main factors that were used to analyse quantitative data were identified and the proposed model of this study was constructed. The proposed model investigated the construct of actual usage of ERP systems. Finally, the fourth objective was to conduct an empirical study and examine the relationships and relevancy among the factors influencing the adoption of ERP systems by HEIs, based on the TAM model.

## **7.2 STUDY FINDINGS AND CONCLUSIONS**

### **7.2.1 Objective One: To Investigate the Current Usage of ERP Systems in HEIs in Saudi Arabia**

Businesses are challenged with creating different types of systems that are capable of working together to seamlessly share and exchange information. One way to overcome this problem is to employ enterprise applications (Bradford, 2011). Enterprise Resource Planning (ERP) systems are used in educational, service, manufacturing, non-manufacturing, government and not-for-profit organisations (Bradford, 2011). The aim is to facilitate the procedures for all business roles within the precincts of the company and also to manage links to external firms (Wang and Wang, 2014).

The implementation of ERP systems is considered to be a complex, costly and time-consuming approach for project management (Scott and Vessey, 2002; Ramayah et al., 2007; Helo et al., 2008; Maditinos et al., 2012). Past studies have indicated that failure to adopt ERP is greater among HEIs than among businesses (Blitzblau and Hanson, 2001; Abugabah and Sanzogni, 2010; Al Kilani et al., 2013; Botta-Genoulaz and Millet, 2006). This is particularly important in HEIs because the complexity of implementation and the integration of information systems is considerably higher (Ram et al., 2013). Generally, HEIs are more opposed to change than private firms because of the loosely integrated and autonomously functioning administrative and academic units (Gates, 2004), alongside a decentralised authority structure (Rabaa'i et al., 2009). This uniqueness makes it more complex for technological developments to penetrate the normal schedule of service delivery in HEIs (Rabaa'i et al., 2009).

Current ERP research has ignored the global higher educational sector, even though several HEIs are implementing or have implemented an ERP system (Nielsen, 2002). Therefore, research on issues pertaining to ERP and HEIs represent a major feat in the analysis of the real benefits that are potentially brought by such systems to HEIs. Although ERP systems currently represent huge investments in terms of software within HEIs, it is unlikely to be final. Universities are seeking to install and renew other business-wide systems in the future (Nielsen, 2002) and so this makes it necessary to conduct research on this area.

An extensive search of the literature (including journals, books, articles and Google Scholar) was conducted to locate studies related to ERP systems in HEIs, particularly those located in Saudi Arabia. However, only 12 studies were found be related to ERP systems in HEIs in Saudi Arabia (see Chapter Two). There were several topics of interest to different researchers of ERP systems: change management and processes, critical success factors (CSFs), stakeholder performance, technical and social. These topics address some of the gaps in the field of ERP adoption studies in HEIs, but there are still some deficiencies in the research.

First, it is notable that the focus of the majority of these 12 studies was to address the technical aspects, the implementation process and CSFs, rather than the social aspects. These may not highlight whether ERP adoption is effective or ineffective for a particular user within a given environment. In fact, because the numbers of available ERP systems are increasing and because many HEIs are adopting them, new research studies are needed to investigate various issues in this context.

Second, there is enough evidence in the IS literature that system users were not included in the system evaluation process, particularly in research studies that have investigated technical factors rather than human characteristics (Khalifa et al., 2001). Despite the capability of the CSF approach to evaluate ERP systems, such an approach is incapable of providing a mean of evolution as well as ensuring the success of technology implementation (Althonayan, 2013). The implementation of an ERP system cannot be considered successful unless the users' attitudes toward the system are positive and match their expectations (Al-Mashari, 2003). Sandhu et al. (2013) argue that the acceptance of ERP systems is one of the CSFs that contribute to the success of ERP implementation.

According to different studies conducted on ERP systems in Saudi Arabia – e.g., Al-Shamlan and Al-Mudimigh (2011) and Zubair and Zamani (2014) – the main reason for ERP failure in HEIs in Saudi Arabia was either the resistance of users to change or the unwillingness of users to accept the new technology. Another study, conducted at a university in Saudi Arabia, indicated that the users' perceptions at the organisational and individual level are not understood (Agourram, 2009). Thus, research studies

should place an emphasis on examining the ways that ERP systems are adopted and utilised by individuals, and more attention should be given to this aspect because it may influence the use of the ERP system that forms the attitude as well as the behaviour of the system users.

Third, it is obvious that the majority of the research studies on ERP systems in Saudi Arabia were conducted on one university – King Saud University (KSU) – and on one type of ERP system (the MADAR system). MADAR was developed at KSU in order to meet budget constraints and so this system cannot be considered a global ERP system like Oracle E-Business Suite and SAP systems. The research results, therefore, may differ from the experiences of other HEIs that have adopted global ERP systems. More research is required to consider other ERP systems and more users' opinions from different universities in Saudi Arabia.

### **7.2.2 Objective Two: To Examine Various Technology Adoption Frameworks for the Implementation of ERP in HEIs**

There have been many research studies dedicated to understanding user acceptance of information technology, and many well-established frameworks, theories and theoretical models have been utilised to this end. Over the past two decades, four theoretical models have governed the theoretical basis of information technology acceptance (Kim and Malhotra, 2005). These models are: (1) the theory of reasoned action (TRA), (2) the theory of planned behaviour (TPB), (3) the technology acceptance model (TAM) and (4) the innovation diffusion theory (IDT). Despite the reputations and recommendations that each model/theory might have gained over the last two decades, each has its own limitations.

The TRA is a general model (Ghorab, 1997) and therefore lacks any specification of which beliefs are effective for a particular context. Moreover, TRA stems from the assumption that behaviour can be controlled, meaning that involuntary behaviours are not described or made clear by this model (Ajzen and Fishbein, 1980). In addition, several researchers advised that TRA needs extra explanatory factors (Thompson et al., 1991).



Despite the fact that TPB is a well-established model, it ignores both demographic and cultural effects on user behaviour (Manoi, 2007). According to TPB, individuals' behaviours are planned; however, the model has failed to show how such planning is related to the model and does not explain how individuals plan toward such behaviours. Additionally, the model utilises the PBC variable in order to examine uncontrollable elements of behaviour. However, from a psychometric point of view, subjective norms – which can be considered as uncontrollable elements of behaviour – may not have any impact on behavioural intention, particularly in voluntary usage (Davis et al., 1989).

The limitations of IDT stem from its weakness of not reliably examining constructs (Agarwal and Prasad, 1999). The model also does not take into consideration the influence of demographic factors such as age and gender on users' attitude toward IT acceptance. In addition, Agarwal and Prasad (1999) claimed that the definition of IDT factors has “methodological” drawbacks.

TAM has received sufficient attention in the literature, but not without criticism. For instance, the original version of TAM lacks rigorous and sufficient research (Chuttur, 2009). Another criticism noted by Segars and Grover (1993) was regarding TAM's utilisation of confirmatory factor analysis to re-construct another model using different factors (e.g., ease of use and usefulness). Different research studies have, however, attempted to extend TAM's theoretical basis to overcome some of these drawbacks. For instance, the results of extending the original TAM to TAM2 (proposed by Venkatesh and Davis, 2000) significantly supported the model formulation. Mathieson (1991) compared TAM and TRA in a study of spreadsheet acceptance and the result indicated that perceived ease of use (PEU) and perceived usefulness (PU) were significant factors that affected usage. Taylor and Todd (1995) also made a comparison of TAM, TPB and DTPB and established that TAM had been successful in predicting the use of a computer resource centre. This was vital in adding to the growing support for the model.

The TAM model has received significant support from various empirical research studies (Venkatesh and Davis, 2000; Venkatesh, 1998; Taylor and Todd, 1995;

Mathieson, 1991) as compared with other models (such as TRA, TPB and IDT). However, a significant variation exists with regard to IT acceptance. Major users are not consulted when investing in IT, such as ERPs. Nah et al. (2004) have shown that the variation, which characterises technology acceptance within mandatory contexts, has not been explained by Davis' TAM model (1989) or by Venkatesh and Davis' expanded TAM model (2000). Additionally, fairly simple technologies – such as email and word processors – have been adopted (Venkatesh et al., 2003), with relatively little attention being given to complex and mandatory technologies such as ERP systems. ERP systems are very complex, which may negatively affect an individual's PEU as well as PU (Momoh et al., 2010).

Nevertheless, most of the existing models, theories and frameworks have failed to completely explain the reasons why a certain technology is unacceptable or acceptable by its users (Al-Jabri and Roztocki, 2015). Moreover, according to Brown et al. (2002), voluntary adoption of the technology was presumed by many researchers where the rejection of new technology was optional. However, in the real sense, there are instances when a specific IT is mandated, which makes it difficult for users to reject it (Al-Jabri and Al-Hadab, 2008).

A number of research studies have been conducted on ERP systems using TAM with positive results. However, the finding of this research study indicates that few studies have investigated ERP user acceptance and usage and that only a small number of articles have been published, which is consistent with the findings of Zabukovsek and Bobek (2013) and Sternad et al. (2013) – see also Section 3.3 in Chapter Three. There is a lack of research investigating the adoption of ERP systems in the HEI environment. In addition, there is inadequate research that attempts to develop a conceptual framework (which is the focus of this research) for ERP adoption in HEI from the users' technology acceptance point of view, despite the fact that HEIs are still adopting ERP systems.

Additionally, the majority of the previous studies have focused only on the behavioural intentions or attitudinal factors as the determining factors of ERP system usage. In fact, examining the actual system usage rather than only examining the usage intention

– as well as coinciding with an assessment of the framework, rather than dividing assessments of different parts of the framework – will boost the new proposed framework. This necessitates the development of a theoretical model that explains technology acceptance in a mandatory environment. Based on the above discussion, TAM was chosen as the baseline framework/model in this research.

### **7.2.3 Objective Three: To Identify the Factors Affecting the Adoption of ERP Systems in HEIs in Saudi Arabia and Develop a Theoretical Model**

In this research study, two main categories of factors have been adopted. The first category is individual factors – subjective norm (SN), computer self-efficacy (CSE) and computer anxiety (CA). The second category is organisational factors – top management support (TMS) and user training (UT). These factors have been validated in different empirical studies and have strong support in the literature.

Various procedures were utilised in order to assess and develop the research model. The initial phase of this research used a literature review as the main approach to identify the factors that affect the adoption of ERP systems by HEIs. The main aims for using the literature review were to:

- Gain an understanding of the existing theories and models in the field of users' acceptance of technology.
- Identify existing evidence that may lend support to the proposed model structure.
- Choose the baseline model (TAM) that is used to determine the important factors that may affect the adoption of ERP systems by HEIs.
- Establish a conceptual framework to design the research questionnaire.

In the second phase, based on the literature review of ERP systems and the TAM model, the main factors that were used to analyse quantitative data were identified and the proposed model of this study was constructed. Two organisational factors, three individual factors and five TAM factors (altogether consisting of 56 items from the finalised questionnaire) were developed. Based on the literature review of ERP

systems, the extracted external factors (individual and organisational factors) that may affect the adoption of ERP systems by HEIs were added to the original TAM model and utilised for further analysis.

In the third phase, CFA was applied to examine the validity of the hypothesised measurement model. In other words, CFA was used as the next step in order to accept or reject the proposed model. The resulting measurement model indicated a satisfactory model fit after some modifications. As mentioned in Section 6.5.2 of Chapter Six, the structure model showed an acceptable level of fit to the data (RMSEA = 0.054, chi-square/df = 2.163, NFI = 0.931, GFI = 0.902, AGFI = 0.861 and CFI = 0.954). Therefore, the CFA results confirm that the research participants' responses support the conceptual as well as the theoretical uniqueness of all of the factors proposed in this study.

After determining the best-fitting measurement model, two types of tests were used to examine the reliability and the validity of the measurement model in this study: convergent and discriminant validity tests. The results indicated that the convergent validity of the questionnaire was satisfied. The result of discriminant validity indicated that the ten constructs were unique and distinct. The Cronbach's alpha value indicated a high reliability of the questionnaire. Subsequently, all results indicated evidence of strong convergent and discriminant validities for the research questionnaire and factors of the measurement model.

After the confirmatory techniques were accomplished by the use of CFA, structural model analysis was conducted on the proposed model using structural equation modelling (SEM). Building upon the relationship proposed by Davis et al. (1989), as well as the revised measurement model, the structural model (the proposed model) was initiated. Thus, the measurement model was used as the foundation to build the research structural model by adding the estimated path of the relationships between organisational, individual and TAM factors

This study indicated that the research model has shown satisfactory results in explaining the actual use of ERP systems by HEIs. The acceptable fit indices, coupled

with significant model paths, propose the general utilisation of TAM to the adoption of ERP systems by HEIs. Moreover, all results of the items measured indicated evidence of strong convergent and discriminant validities for the research questionnaire and factors of the measurement model. All goodness-of-fit statistics were in the acceptable ranges and indicated an acceptable fit to the data. Additionally, as the majority of the relationships between the constructs assumed by the structural model were supported, this research plays a pivotal role in providing further evidence to support the suitability of applying TAM to examine the acceptance of ERP systems in HEIs.

Based on the findings of this research, there is a lack of research studies that have explained the acceptance of ERP systems in HEIs using TAM, especially with regard to the usefulness and ease of use of ERP. Thus, this research study has extended the TAM model in a previously uninvestigated area and with affirmative outcomes. Accordingly, the third objective of this research study was therefore met.

#### **7.2.4 Objective Four (The Final Objective): To Conduct an Empirical Study and Examine the Relationships and Relevancy Among the Factors Influencing the Adoption of ERP Systems by HEIs, Using the TAM Model**

The main objective of SEM in this research study was to examine the underlying hypotheses in order to identify the factors affecting the adoption of ERP systems in HEIs in Saudi Arabia. Sixteen causal paths that represent hypotheses of the research were added to the fitting measurement model (see Figure 6.5 in Chapter Six). The aim of these hypotheses was to determine the relationship between the factors in the structural model. The hypotheses in this research are directional and, thus, the one-tailed test was employed. The AMOS results revealed that twelve out of sixteen paths were significant.

This study differs from the majority of the previous TAM studies that examine ERP adoption and that simply employ a single construct that is attitude or behavioural intention to utilise a system. The predictive power for the structural model was elucidated by the variance explained ( $R^2$ ) of endogenous constructs and the findings confirmed that the structural model explains a great proportion of the variance in the

endogenous factors. The structural model resulted in 73.1% for ERP PU (due to direct and indirect effects), 70.4% for ERP PEU (due to indirect effects), 77.6% for attitude (A) towards ERP systems (due to direct and indirect effects), 73.2% for intention to use (IU) ERP systems (due to direct and indirect effects) and 53.4% for actual usage (USAGE) of ERP systems (due to direct and indirect effects), providing satisfactory explanatory power. The average variance explained ( $R^2$ ) by the model was 69.5%.

Table 7.1 illustrates the findings of this research study with regard to the effects of the organisational factors, individual factors and TAM on ERP adoption. Furthermore, Table 7.1 indicates whether these findings are consistent or inconsistent with previous research studies.

**Table 7.1: Summary of Study Findings Regarding the Effects of Organisational factors, Individual factors, and TAM Factors on ERP Adoption.**

Research Findings	Consistent with Previous Studies	Inconsistent with Previous Studies
<b>Organisational Factors</b>		
User training (UT) will have a direct and positive effect on the PEU and PU of ERP systems.	Bradley and Lee (2007); Amoako-Gyampah and Salam (2004); Lee et al. (2010); Rajan and Baral (2015); Costa et al. (2016)	
TMS will have a direct and positive effect on the PEU and PU of ERP systems.	Davis et al. (1989); Ngai et al. (2007); Shih and Huang (2009); Lee et al. (2010); Rajan and Baral (2015); Costa et al. (2016)	
<b>Individual Factors</b>		
Computer self-efficacy (CSE) will have a direct and positive effect on the PEU of ERP systems.	Venkatesh and Davis (1994); (2000); Venkatesh and Bala (2008); Elkhani et al.	

	(2014); Rajan and Baral (2015)	
CSE will have a positive effect on the PU of ERP systems.		Compeau and Higgins (1995); Agarwal and Karahanna (2000); Venkatesh and Davis (1996); Shih (2006); Kwahk and Ahn (2010); Rajan and Baral (2015)
Computer anxiety (CA) will have a direct and negative effect on the PEU of ERP systems.		Venkatesh (2000); Brown and Town (2002)
CA will have a direct and negative effect on the PU of ERP systems.	Igbaria and Iivari (1995)	
Subjective norm (SN) will have a positive effect on the PU and IU of ERP systems.		Chung et al. (2008); Schepers and Wetzels (2007); Kwak et al. (2012)
<b>TAM Factors</b>		
PEU will have a positive effect on the PU of ERP systems.	Calisir and Calisir (2004); Amoako-Gyampah and Salam (2004); Liu et al. (2005); Hsieh and Wang (2007); Al-Jabri and Al-Hadab (2008); Bueno and Salmeron (2008); Calisir et al. (2009); Al-Jabri and Roztock (2015)	
PEU will have a positive effect on the attitude to use ERP systems.	Al-Jabri and Roztock (2015); Davis (1989); Venkatesh and Davis (2000)	

PU will have a positive effect on the attitude to use ERP systems.	Davis (1989); Davis et al. (1989); Al-Jabri and Roztocki (2015)	
PU will have a positive effect on the ITU of ERP systems.	Davis et al. (1989); Shih (2006); Ramayah and Lo (2007)	
Attitude will have a positive effect on the ITU of ERP systems.	Davis et al. (1989); Bagchi et al. (2003); Calisir et al. (2009)	
IU will have a positive effect on the actual use of ERP systems.	Venkatesh and Davis (2000); Davis (1989); Morris et al. (1997); Bagozzi et al. (1992); Youngberg et al. (2009); Sternad and Bobek (2013)	

#### **7.2.4.1 Effects of Organisational Factors on the PEU and PU of ERP systems**

##### **User Training (UT)**

The findings in this study showed that UT is an important determinant to PEU and PU. This is consistent with that suggested by Bradley (2008), Amoako-Gyampah and Salam (2004), Lee et al. (2010), Rajan and Baral (2015) and Costa et al. (2016). UT showed a strong and direct effect on PEU and PU, albeit stronger with PEU than PU.

##### **Top Management Support (TMS)**

TMS has an influence on the PEU and PU of ERP systems and this finding is consistent with prior research. For instance, Davis et al. (1989), Ngai et al. (2007), Shih and Huang (2009), Lee et al. (2010), Rajan and Baral (2015) and Costa et al. (2016) all indicated that TMS strongly and positively affects the PEU and PU of ERP systems. Additionally, the direct effect of TMS on PEU was stronger compared to the direct effect of TMS on PU.



#### **7.2.4.2 Effects of Individual Factors on the PEU and PU of ERP systems**

##### **Computer Self-efficacy (CSE)**

CSE was found to have a strong positive influence with a direct effect on the PEU of ERP systems, which is consistent with different technology acceptance research studies (Venkatesh and Davis, 1994; 2000; Venkatesh and Bala, 2008; Elkhani et al., 2014; Rajan and Baral, 2015). Furthermore, the findings revealed that CSE was the major determinant of PEU, which is consistent with the Venkatesh and Davis (2000) study. Additionally, the findings indicated that CSE had the strongest indirect effect among other external factors upon the usage of ERP systems in HEIs.

In contrast with other research studies (such as: Compeau and Higgins, 1995; Agarwal and Karahanna, 2000; Venkatesh and Davis, 1996; Shih, 2006; Kwahk and Ahn, 2010; Rajan and Baral, 2015), CSE was found to have no influence on the PU of ERP systems. A possible explanation for this finding is that the complex nature of ERP systems may reduce a user's self-efficacy and consequently limit the amount of understanding regarding the usefulness and the benefits of the technology during the adoption phase.

##### **Computer Anxiety (CA)**

CA was found to have a negative influence with a direct effect on the PU of ERP systems, which is consistent with the research of Igbaria and Iivari (1995). A possible explanation for this relationship is that users with low CA levels were looking for more facilities and benefits from the ERP systems.

CA was found to have no influence on the PEU of ERP systems, which is inconsistent with the research of Venkatesh (2000) and Brown and Town (2002). However, the findings of the current study are consistent with prior research studies (such as: Venkatesh and Davis, 2000; Thompson et al., 2006) that argue that due to a user's experience of technology the PEU of information technology is less affected by individual factors (e.g., CA) and more linked to particular characteristics of the software.

### **Subjective Norms (SN)**

SN can be defined as an “individual’s perception that most people who are important to him/her thinks he/she should or should not perform the behaviour in question” (Fishbein and Ajzen, 1975:302). SN was found to have insignificant effects on the PU and behavioural intention of ERP systems, which is both consistent with previous research studies (such as: Mathieson, 1991; Davis et al., 1989; Venkatesh and Davis, 2000; Davis et al., 1989; Chismar and Patton, 2002; Seymour et al., 2007) and inconsistent with other research studies (such as: Chung et al., 2008; Schepers and Wetzels, 2007; Kwak et al., 2012).

There are two possible explanations for this inconsistency in research findings. First, as the time of ERP implementation increases, the effect of SN on users’ PU or IU of ERP systems became less effective. Venkatesh et al. (2003) concluded that the influence of SN on ERP users is often during the early adoption stage. Second, the diverse culture and the advanced levels of education of users in HEI contexts means that they may develop independent thinking and evaluation that may outweigh others’ opinions and their peers’ expectations.

#### **7.2.4.3 Relationships Between TAM Factors**

In terms of the relationships between TAM factors, the findings of this research study were consistent with various technology acceptance studies (Davis, 1989; Davis et al., 1989; Venkatesh and Davis, 2000) and with some ERP studies (Amoako-Gyampah and Salam, 2004; Hsieh and Wang, 2007; Al-Jabri and Al-Hadab, 2008; Bueno and Salmeron, 2008; Calisir et al., 2009; Lee et al., 2010; Al-Jabri and Roztockki, 2015).

#### **The Perceived Ease of Use (PEU) of ERP Systems**

Despite the considerable amount of research on ERP adoption by the use of TAM, not all researchers support the relationship between PEU and PU (Venkatesh and Morris, 2000; Agarwall and Prasad, 1999; Shih and Huang, 2009; Blackwell and Charles, 2006). However, the findings of this study show that PEU has a significant impact with a direct effect on the PU of ERP systems, which is consistent with Davis (1989), Davis et al. (1989), Calisir and Calisir (2004), Amoako-Gyampah and Salam (2004), Liu et al. (2005), Hsieh and Wang (2007), Al-Jabri and Al-Hadab (2008), Bueno and Salmeron (2008), Calisir et al. (2009) and Al-Jabri and Roztockki (2015). Additionally,

the findings of this study indicate that PEU has a significant impact with a direct effect on attitude toward ERP systems, which is consistent with Al-Jabri and Roztocki (2015), Davis (1989) and Venkatesh and Davis (2000).

#### **The Perceived Usefulness (PU) of ERP Systems**

PU was found to have a positive influence with a direct effect on attitude. This is consistent with the findings of Davis (1989), Davis et al. (1989) and Al-Jabri and Roztocki (2015). PU was also found to have a positive influence and a direct effect on the ITU of ERP systems, which is consistent with Davis et al. (1989) and Shih (2006). Moreover, the findings of this study indicated that PU was more strongly related to the ITU of ERP systems than other factors, which is consistent with Ramayah and Lo (2007).

#### **Attitude (A) Towards ERP Systems**

According to Venkatesh et al. (2003), attitude towards ERP systems has no significant effects on ERP acceptance. However, the findings of this study showed that attitude towards ERP systems had a positive influence with a direct effect on the IU of ERP systems, which is consistent with Davis (1989), Davis et al. (1989), Bagchi et al. (2003) and Calisir et al. (2009).

#### **Intention to Use (IU) ERP Systems**

The findings of this study indicated that the IU of ERP systems has a strong and positive influence with a direct effect on the use of ERP systems, which is consistent with several research studies (such as: Venkatesh and Davis, 2000; Davis, 1989; Bagozzi et al., 1992; Youngberg et al., 2009; Sternad and Bobek, 2013).

#### **7.2.4.4 Demographic Differences in the Study's Constructs**

After a thorough examination of the conceptual model of the research, ANOVA was utilised in the current study in order to evaluate the differences between users with respect to their gender, experience, department, education, age, place of residence and marital status.

##### **Gender**

Blackwell and Charles (2006) examined the behavioural intention of ERP systems and concluded that gender is a significant predictor of users' intentions. The findings of this study showed that the intention of males to use ERP was higher than the intention

of females. This finding is consistent with Pasaoglu (2011), who concluded that the intention of women to use ERP system is lower than the intention of men.

Males and females are different in their decision-making processes and often apply different socially constructed cognitive structures (Venkatesh and Morris, 2000). Males are pragmatic and more highly task-oriented when compared with females (Minton et al., 1980). Hoffmann (1980) argued that males often place a greater emphasis on earnings and are usually motivated by achievement needs. This indicates that males place a higher importance on the perceived usefulness of the system.

Harrison and Rainer (1992), who studied the relationship between gender and technology, found that males have higher computing skills than females. Generally, females have lower computer self-efficacy and higher computer anxiety compared to males. This higher computer anxiety will lead to a reduction in the perception of ease of use of the system (Venkatesh and Morris, 2000). This was supported by Igbaria and Chakrabarti (1990), who concluded that females have higher levels of computer anxiety than males.

### **Experience**

According Poon (2007), an individual's experience can be measured through his/her level of experience of using a particular technology for a number of years and greater levels of experience will result in a more stable and a stronger behavioural intention relationship. Individuals' intentions could be formed based on the knowledge that they have gained from their prior experience (Fishbein and Ajzen, 1975).

The findings of this research, however, revealed that experience does not directly influence a user's intention. This is consistent with Venkatesh et al. (2003), who concluded that the relationship between experience and behavioural intention to use technology is insignificant. This might mean that users do not consider computer skills as an important obstacle anymore. A possible explanation for this is that in the past using technologies might have been strenuous or required intensive training in order to persuade users to adopt them. Previous research (Agarwal and Prasad, 1999; Harrison and Rainer, 1992) indicated that significant technology skills were needed even for simple systems such as spreadsheets, word processing and emails. However,

information systems have now become much easier to use than they were in the past (Kamhawi, 2008) and a new generation of users who are exempt from the difficulties of using technologies has taken over. Additionally, according to Turban et al. (2005), one of the ways of overcoming any information system difficulties is the use of professional assistants to aid users in the use of advanced technologies.

### **Department**

The findings of this research showed that the department within which a subject works has no significant effect on their intention to use the technology. There are possibilities that the lack of department differences might be attributed to the sample being studied. The participants involved in this study were users of ERP from various HEIs in Saudi Arabia and they worked in similar departments. They were likely to possess some experience in using information technology and engaging in ERP educational courses. Such exposure before the study was conducted might have contributed to the similarity between the demographics, as shown in the results.

### **Education**

Educational level is an important factor for the acceptance of a technology (Poon, 2008). According to Agarwal and Prasad (1999), educational level is an indication of the ability of potential users to learn. Thus, it should be positively associated with the perceived ease of use and the perceived usefulness. The findings of this research showed that users who hold a Masters or PhD degree had higher ratings for the intention to use ERP systems compared to users in other educational categories. A possible explanation for such differences is that users with a university education had more knowledge about information technologies and therefore they intended to use the ERP system more than other uneducated users. This is consistent with previous research studies (Pasaoglu, 2011; Lymperopoulos and Chaniotakis, 2005), who found that users' educational levels affect the behavioural intention to use the technology.

### **Age**

In the current research study, it was found that the age variable had no influence on technology acceptance and intention to use ERP systems. This is inconsistent with other research studies who confirmed the importance of age and its direct influence on behavioural intention and acceptance of technology. For instance, Sun and Zhang

(2006) concluded that the relationship between perceived usefulness and behavioural intention to use the technology was stronger for younger users than for older users. This is because older users usually have low computer self-efficacy and consider their age to be a barrier to learning new technologies (Tarhini, 2013). This was supported by previous research studies (Morris and Venkatesh, 2000; Morris et al., 2005), who indicated that older users usually have greater difficulties in learning new software applications; whereas, younger users have low levels of computer anxiety and are more likely to engage in opportunities to learn new technologies.

There is also some evidence, however, that challenges these conclusions and suggests that age does not play a role in explaining technology acceptance and adoption. For example, Dickinson and Gregor (2006) studied different age groups and found no differences in technology adoption and usage. Chung et al. (2010) found that the age variable had no effects on perceived ease of use, perceived usefulness or behavioural intention. Others, like Lee et al. (2010), also found that age has no direct influence on a user's intention.

At the present time, users are more self-assured in using information systems than they were in the past. This stems from the continuous improvements in information technology and information technology educational programmes. For example, Saudi Arabia has continued to upgrade and improve their technology infrastructure and offers a variety of information technology training programmes to citizens regardless of age; thus, making this information technology and all its benefits available equally to all citizens. With these increased information technology training efforts, both old and young have equivalent opportunities to use information systems with no disparity between them.

### **Place of Residence**

The findings of this research showed that for the majority of factors the ratings for users who live in Riyadh were significantly higher than those who live in other cities. A possible explanation for these differences is that users who live in Riyadh (the capital of Saudi Arabia) might have better knowledge centres, better quality services and better educated workforces than other geographical areas in Saudi Arabia. This is consistent with the study of Windrum and Berranger (2002), who concluded that the

adoption of technology within a region is related to the existing range and quality of resources.

### **Marital Status**

Chawla and Joshi (2018:97) defined marital status “as the status of an individual where he is living as a single, married, divorced or widowed”. The findings of this research showed that the marital status of an individual has no significant effect on their intention to use the technology. This finding is consistent with Gan et al. (2016), who found that marital status has no significant influence on the adoption of technology.

This analysis indicated that there were significant differences with regards to some demographics (e.g., gender, education and place of residence) in the study’s constructs. However, some of the demographics in this study (e.g., experience, department, age and marital status) show no significant differences. Therefore, the current study provides empirical evidence that not all demographic factors influence technology acceptance and adoption.

## **7.3 RESEARCH IMPLICATIONS**

The final model presented in this research study has both practical and theoretical implications for academia by extending the body of knowledge of the existing literature and research related to technology acceptance and, more specifically, ERP adoption. Furthermore, it provides conceptual implications by providing various insights for the management, practitioners and decision makers involved in the adoption of ERP systems; helping them understand and identify the factors that may affect the adoption of ERP systems by HEIs.

ERP systems involve complex technology and, thus, HEIs need to understand and identify factors in terms of organisational and individual factors. The recognition of the effects of organisational and individual factors will boost the understanding of technology adoption decisions. The research model inclusively linked five external factors (organisational and individual factors) to PEU, PU and ITU, which was assumed to subsequently affect the actual usage of ERP systems in HEIs.

The inclusion of the external factors – organisational factors (TMS and UT) and individual factors (SN, CSE and CA) – and internal factors (PEU, PU, A, IU and USAGE) and backed with a quantitative approach, data collection and analysis helped to develop a meaningful model. This will assist in identifying the research gap that may help practitioners and decision makers in HEIs to make appropriate decisions. Additionally, it will support in answering the research questions and developing a better understanding of the importance of factors that may affect ERP adoption in HEIs. The findings of the current research study clarify that the technology acceptance model is a powerful model that can be utilised to understand users' adoption of ERP system in HEIs.

In addition to the theoretical implications, the research model may enhance the adoption success rate by suggesting practical implications for ERP adoption and developing an understanding of how to enhance ERP usage in HEIs as follows:

**FIRST:** The current study found that both organisational factors (TMS and UT) and individual factors (CSE and CA) play an important role in the adoption of ERP systems in HEIs. Under the organisational factors, the findings indicated that both UT and TMS are key determinants of the PEU and PU of ERP systems. Both factors were more strongly related to PEU than PU. Additionally, the factors showed acceptable indirect effects on ERP usage.

It is worth noting that the direct effects of UT on PEU and PU and the indirect effects of attitude, IU and USAGE were stronger compared to the effects from TMS. This indicates that users who have adequate ERP training are more likely to find the systems easy to use and more useful, which in turn may affect their attitude, IU and subsequently their actual use of ERP systems. However, both factors will play an imperative role in encouraging ERP users to use the system and understand the advantages that can be obtained from using it. Furthermore, they will help users understand the new system, decrease anxiety, enhance their interaction with systems, get rid of any doubts about technology and ultimately develop adequate perceptions with regard to the use of the system and consequently their adoption.



Training and support processes may not only illustrate users' perceptions but also explain the capability of ERP systems to improve work performance. This sheds light on the importance of organisational factors in influencing the perceptions of ERP users. As a result, it is essential for the management and decision makers of HEIs to endow their users with sufficient training and support in the course of ERP implementation and to encourage users to use the system.

Under the individual factors, subjective norms had no direct or strong indirect effect on perceived usefulness, intention to use and actual use of ERP systems. However, CSE and CA will remain predominant factors that can improve users' moral and cause success for ERP adoption. The findings revealed that the path value from CSE to PEU had the strongest effect. Additionally, the findings indicated that CSE had the strongest indirect effect among other external factors upon the usage of ERP systems. This result indicated that ERP users with high self-efficacy are more likely to find the systems easy to use and, consequently, they may use the system more frequently. On the other hand, CA was found to have a strong influence with a direct effect on the PU of ERP systems. This shows that users with low CA are more likely to perceive the technology as useful.

These significant relationships are prominent for HEI technology developers and ERP adoption teams. During the ERP system adoption process, the adoption team and technology developers may utilise systems to the workplace to assure suitable fit. However, if the system users develop fear or uncertainty regarding the adopted systems, they may find these systems useless and/or may find them difficult to use. HEI developers and adoption teams should pay attention to these factors when designing ERP systems and should provide more training courses designed to improve users' CSE and CA levels, which might then improve user acceptance of the systems.

Increasing training and support, as well as improving CSE and CA of using ERP systems by HEI users, are critical issues for getting a better understanding of the actual use of ERP systems. The adoption success rate of ERP systems could rely on the interaction and relationships between these factors and their effects on users' perceptions and actual use of the system. Therefore, proper management of these four

factors, both during and after the adoption process, should influence the usage of ERP system and, thus, increase the probability of adoption success.

SECOND: Some other interesting findings in the current research were the direct and indirect relationships between the TAM factors. As hypothesised in the final model, the path value from PEU to PU had the strongest direct effect value. This indicates that the users might perceive the systems as useful if they were easy to use. HEI implementation teams and technology developers need to consider the degree of technological difficulty when adopting ERP systems. ERP users who do not perceive the system as easy to use and useful tend to form unfavourable attitudes towards using the system.

The paths values from PU to attitude and to IU had the strongest effect values. In addition, PU had the strongest indirect effect on ERP usage among other factors. This denotes that users might have more attitude, intention and eventually more actual use of the ERP system if the system was perceived by its users as useful. These relationships are also important for HEI technology developers and adoption teams; thus, they should pay attention to PU by enhancing the efficiency and productivity of the system so that ERP users can easily realise the benefits that stem from using it.

The findings of this research study reveal that attitude is an important factor in IU. The path value from attitude to IU had the strongest direct effect value. This significant relationship is notable for HEI adoption teams and technology developers, because unfavourable attitudes will negatively affect users' intention toward usage. Therefore, it is highly advisable that HEIs enhance users' attitudes, as this would directly improve their intention to use the system. This can be achieved by reducing the complexity of the system as well as by improving its productivity.

IU was found to be the most important factor that can affect the adoption of ERP systems by HEIs. The path value from IU to ERP USAGE had the strongest direct effect value. This indicates that high IU levels may increase the frequency of ERP use. Since this factor had the most significant effect on ERP usage, HEI adoption teams, administrators and technology developers might concentrate their efforts to encourage

users' IU and USAGE of the system by creating ease of use and useful perceptions that may in turn develop favourable attitudes toward IU.

In summation, this study confirms that UT, TMS, CSE, CA, PEU, PU, attitude and IU are the major criteria that must be carefully considered in order to ensure the successful implementation of an ERP system and to increase users' adoption.

## **7.4 RESEARCH CONTRIBUTIONS**

Based on the results of this study, the following subsections provide the main contributions that are related to the research model, research measurement scales, extension of the TAM model, decision making and extension of managerial perspective. This study has made the following contributions:

### **7.4.1 Contribution 1 – Research Model**

The development of a new model contributes to the understanding of technology adoption in general and more specifically to ERP adoption in HEIs. The model used in this study extends previous research by incorporating organisational and individual factors from previous literature and theories. Despite the wide recognition of these factors in previous models, however, the majority of studies, if not all, have failed to apply them into a single model to understand their influences on ERP adoption in the higher education field. This insufficient comprehensive research on the adoption of ERP systems in the higher education sector and the small number of factors considered by previous research studies motivated this research study.

The study developed a coherent model that combined factors that have been validated in different empirical studies and have strong support in the literature. This study identifies these factors, verifies them, illustrates the differences between them and tests their significance on the adoption of ERP systems by HEIs. The findings of this research confirm the significant role that both organisational and individual factors play in influencing users' perceptions and acceptance of ERP adoption. Therefore, this research study and model contribute to the information systems literature by elucidating that users' perceptions are very important to the adoption and

implementation of ERP systems. Moreover, the research model will be able to offer a new framework for future research in the adoption arena.

#### **7.4.2 Contribution 2 – Research Measurement Scales**

The demonstration of various measurement scales of ERP adoption adds a further contribution of this study. The findings indicated that the research model has provided satisfactory results in explaining the actual usage of ERP systems in HEIs. The acceptable fit indices, coupled with significant model paths, play a pivotal role in providing further evidence to support the suitability of applying the TAM model to examine the acceptance of ERP systems in HEIs.

Moreover, the empirical validation of the research survey measure for the factors examined in the current study adds further theoretical contribution by highlighting the measurement and conceptual issues related to the development of ERP theories. Therefore, this study provides further theoretical understanding in how ERP systems can be adopted. These measures can also be adopted by HEIs to investigate other emerging technologies.

#### **7.4.3 Contribution 3 – Extension of the TAM Model**

Based on the findings of this research, few research studies have explained the acceptance of ERP systems in higher education using TAM, especially with regard to ERP usefulness and ERP ease of use. Perhaps this is the first study to examine factors that affect ERP adoption in HEIs in a developing country rather than a developed one. Thus, this research study has generated contemporary research strands of ERP implementation theory and adoption by extending the TAM model in an uninvestigated area with positive outcomes.

#### **7.4.4 Contribution 4 – Decision Making**

This study could be very beneficial to decision makers in HEIs because the model developed can help to predict users' adoption of ERP systems. In addition, it can provide useful insights towards the relationship between the factors and the actual use of ERP systems. The results of this research study should enable HEI adoption teams and technology developers to better understand the key determinants of user

acceptance of a new system and to realise how different decisions made by the adoption teams and technology developers may influence the success of the new systems they produce. Therefore, the proposed model serves as a framework for thinking through and establishing different requirements and development criteria for the new system.

The results of this study showed that both the PEU and PU of ERP systems play an important role in ERP adoption. The information obtained from these two factors and the significant relationships between them and with other constructs provides a great advantage to those who are responsible for the adoption process of ERP systems. For instance, HEIs could direct the efforts of the adoption teams and technology developers towards high priority design configurations and conduct a trial run of the new system. A survey could be conducted and managed close to the end of the trial in order to examine the users' PEU and PU of the ERP system. This will help HEIs to make more precise decisions regarding the adoption process, as well as helping them to get rid of the productivity paradox. In the long run, information system users' attention will grow dramatically with regard to the usefulness of the systems. Consequently, HEI adoption teams and technology developers need to consistently improve their systems to meet organisational objectives.

#### **7.4.5 Contribution 5 – Extends Managerial Perspective**

This study extends the managerial perspective by highlighting the importance of UT and TMS in managing ERP adoption. The results of this study support the idea that UT and TMS are important factors affecting employees' perceptions of ERP systems. This implies that higher education administrators, managers and decision makers play an increasing role in making decisions regarding the training and support of their employees. Thus, to enhance user perceptions, new strategies are required that focus on providing adequate training and support to the system users. This will help users to build realistic expectations of the new system that are more likely to be met and will therefore increase the usage of the ERP system.

UT and TMS will also help in enhancing the perceptions of users who have low CSE and high CA levels with regard to the new system. ERP systems require a vast amount

of time and project-management dedication before achieving the desired outcomes. Therefore, understanding how to determine factors of users' adoption of ERP systems can also be important for higher education administrators, managers and decision makers because it could speed up the rate of adoption. Finally, because IU is the most influential factor upon employees' usage of ERP systems, higher education administrators, managers and decision makers should place a special emphasis on this factor by carefully supporting their employees in order to gain the required skills and thereby increase the usage rate of ERP systems.

Significant educational differences were found for the majority of the factors (PU, attitude, IU, USAGE, UT, TMS and CA), except for PEU and CSE. This is consistent with Lymperopoulos and Chaniotakis (2005), who found that educational levels influence users' attitude towards usage. Other studies (such as: Agarwal and Prasad, 1999; Tih et al., 2008) concluded that the educational levels of system users are an important factor in technology acceptance.

## **7.5 RESEARCH LIMITATIONS**

This research study expanded prior research by incorporating organisational and individual factors as the external factors influencing the PEU and PU of ERP systems. However, there are other significant external factors – such as technological characteristics (e.g., accessibility, functionality and design), individual characteristics (e.g., computer experience and technological innovativeness) and organisational characteristics (e.g., perceived resources, business processes and communications) – that can affect the adoption of ERP systems by HEIs that also need to be better understood in terms of their effects on PEU and PU. The additional inclusion of these relevant factors could help by increasing the exploratory power of the model and provide further explanations regarding the actual use of ERP systems.

Another limitation of this research is related to generalisability, because the data was collected from HEIs operating in a developing country (Saudi Arabia); therefore, the results of this research might not be applicable to other institutions operating in developed countries. This is because both organisational and individual factors differ from one culture to another. Thus, similar research with a different setting could

generate different findings. However, the results of this study could possibly be generalised to other developing countries that possess similar circumstances and strategies as Saudi Arabia.

The scales of the measurement items in this research were self-reported rather than observed. ERP users expressed their perceptions based on their perspectives on ERP systems, which might have been subjective and inexplicit. More precise results may be obtained from future research if authors applied observable settings to examine users' adoption of ERP systems.

This study applied quantitative analysis to examine the usage of ERP systems in HEIs at a given point in time. Users' perceptions may change over time and subsequently this could affect their behavioural intention towards usage. A more accurate measure may be conducted in the future to explore users' usage in a longitudinal, qualitative and quantitative study. This information could help in providing a better understanding of users' perceptions, which in turn will assist HEIs to effectively administer their employees' adoption of ERP systems.

The final limitation of this study is related to the gender of the participants of this research, who were primarily male. Caution should be exercised when interpreting the results of the present study in terms of the differences in intention and usage between male and female respondents, due to the relatively small number of female respondents. Future research should strive for a much higher female representation than the current study has managed to achieve and/or could examine the model of this study on female users.

## **7.6 RECOMMENDATIONS AND FURTHER RESEARCH**

The current research study has developed a model with important findings on the relationships between factors encompassing organisational and individual factors and their effects on ERP adoption in HEIs. Based on the results of this study, the subsections that follow provide recommendations for higher education management and further research.

#### **7.6.1 Recommendation 1 – Endow Users with Sufficient Training and Support**

UT and TMS strongly influence the perceptions of ERP users. As a result, it is essential for HEI management and decision makers to endow users with sufficient training and support in the course of ERP implementation and to encourage users to use the system. HEI adoption teams and technology developers should pay particular attention to users who possess a low level of CSE and high levels of CA. They can then support them by providing more training courses that are designed to improve CSE and CA.

#### **7.6.2 Recommendation 2 – A Trial Run of the New System**

The results of this study showed that both the PEU and PU of ERP systems play an important role in ERP adoption. HEIs could direct the efforts of the adoption teams and technology developers towards high priority design configurations and to conduct a trial run of the new system. A survey could be conducted and managed close to the end of the trial in order to examine the users' PEU and PU of the ERP system. This will help HEIs to make more precise decisions regarding the adoption process, as well as helping them to get rid of the productivity paradox.

#### **7.6.3 Recommendation 3 – Recruit Personnel with These Characteristics in Mind**

In terms of future employment, human resource departments in HEIs could use these “psychological” and emotional characteristics in their hiring processes. Questions related to these characteristics could be encompassed in their employment forms and candidates who possess high competencies in these areas should be preferred.

#### **7.6.4 Recommendation 4 – Enhance the Efficiency and Productivity of ERP Systems**

PU had the strongest effect on attitude and IU; therefore, HEI implementation teams and technology developers should pay attention to PU by enhancing the efficiency and productivity of the system so that ERP users can realise the benefits that stem from using it.



### **7.6.5 Recommendation 5 – Increase the Usage Rate of ERP Systems**

IU is the most influential factor on employees' usage of ERP systems; therefore, higher education administrators, managers and decision makers should place a special emphasis on this factor by carefully supporting their employees in order to gain the required skills and thereby increase the usage rate of ERP systems.

### **7.6.6 Recommendations for Future Work**

Future work should explore other factors that may have an effect on ERP usage. The research model could, therefore, be enhanced by incorporating and examining the role of other direct determinants of actual use of ERP systems. Furthermore, other models/theories could be integrated to improve the research model – such as the Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Dishaw and Strong (1999) and the Yield Shift Theory of Satisfaction (YST) developed by Briggs et al. (2008). The UTAUT model, for example, includes TAM and other models of user behaviour and intention. Therefore, future research could replicate the current study by using this model and may provide significant advances in the ERP adoption arena. Alternatively, the YST model identifies ten observed satisfaction influences that are related to users' perceptions regarding specific technology. These influences seem quite promising and could be included in further research to examine ERP adoption in mandatory environments.

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## APPENDIX A: THE ENGLISH INSTRUMENT

### Business School

#### University of Bolton

**Aim of the Study:** This study is designed to investigate the factors that affect users' adoption of ERP system in higher educational institutions in Saudi Arabia. I am inviting you to participate in this research study to find the important factors that may affect the users' adoption of ERP system in Saudi Arabia?

**Participation:** Participation in this research is voluntary. Thus, you are free to decide on whether you would like to participate or not. If you decide not to participate or you do not wish to answer any of the survey's questions, you will not be subject to any penalties in any way. You may withdraw your data at any time of the study. All the information collected via the survey including your responses will be anonymous.

Thank you a lot for taking time out of your busy schedule to contribute to this effort. I personally thank you for helping me to complete this research.

Researcher,

Mohammed Albarghouthi

[MA15MPO@bolton.ac.uk](mailto:MA15MPO@bolton.ac.uk)



1- Gender:

☐

Male

☐

Female

2- Your experience in current job:

☐

Less than 1 year

☐

1-3 years

☐

3-6 years

☐

More than 6 years

3- Your Department:

☐

Finance Department

☐

Registration Department

☐

HR Department

☐

Other -----

4- Level of Education:

☐

High School or less

☐

Diploma

☐

University Degree

(BA)

☐

Master or PhD

5- Age

☐

Under 20

☐

20- under 30

☐

30- under 40

☐

Above 40

6- Place of residence

☐

Riyadh

☐

Jeddah

☐

Dammam

☐

Other

7- Status

☐

Single

☐

Married

☐

Other

8- Are you user of ERP System?

☐

Yes (go to questions number 9, 10 and 11)

☐

No (Thank you)

9- Using a rating scale of 1 to 7, please circle the number that indicates your level of disagreement/agreement with the following statements:

No	Item	Strongly disagree								Strongly agree
	<b>Perceived Usefulness</b>									
1	Using the ERP system would allow me to accomplish my tasks more quickly	1	2	3	4	5	6	7		
2	Using the ERP would improve my performance	1	2	3	4	5	6	7		

3	Using the ERP would enhance my effectiveness in the work	1	2	3	4	5	6	7
4	Using the ERP would increase my productivity in the work	1	2	3	4	5	6	7
5	Using the ERP would make it easier to do my job	1	2	3	4	5	6	7
6	Overall, I find ERP useful in my work	1	2	3	4	5	6	7
	<b>Perceived Ease of Use</b>							
7	Learning to use the ERP is easy for me	1	2	3	4	5	6	7
8	I find it easy to get the ERP to do what I want it to do	1	2	3	4	5	6	7
9	My interaction with ERP is clear and understandable	1	2	3	4	5	6	7
10	Getting the information from ERP is easy	1	2	3	4	5	6	7
11	It is easy for me to become skillful at using ERP	1	2	3	4	5	6	7
12	Overall, I find ERP easy to use	1	2	3	4	5	6	7
	<b>Intention to Use</b>							
13	I intend to use the ERP to do my work	1	2	3	4	5	6	7
14	I intend to use the ERP in other jobs in the future	1	2	3	4	5	6	7
15	I intend to increase my use of the ERP in the future	1	2	3	4	5	6	7
16	Having used the ERP, I would recommend it to my colleagues to use it for work purposes	1	2	3	4	5	6	7
	<b>Attitude</b>							
17	ERP is important to me	1	2	3	4	5	6	7
18	Using ERP is a good idea	1	2	3	4	5	6	7
19	ERP provides a good communication environment	1	2	3	4	5	6	7
20	I like using ERP	1	2	3	4	5	6	7
	<b>User Training</b>							
21	The training provided to me was complete	1	2	3	4	5	6	7
22	The training gave me confidence in the system	1	2	3	4	5	6	7
23	The trainers were knowledgeable and aided me in my understanding of the system	1	2	3	4	5	6	7
24	The training on the operation of the ERP was sufficient	1	2	3	4	5	6	7
25	Overall, my level of understanding was substantially improves after going through the training program	1	2	3	4	5	6	7
	<b>Computer Anxiety</b>							
26	Working with a computer makes me nervous	1	2	3	4	5	6	7
27	Computers make me feel uneasy	1	2	3	4	5	6	7
28	Computers make me feel uncomfortable	1	2	3	4	5	6	7
29	Computers scare me	1	2	3	4	5	6	7
	<b>Subjective Norm</b>							
30	My peers believe in the benefits of the ERP	1	2	3	4	5	6	7
31	My management team believes in the benefits of the ERP	1	2	3	4	5	6	7
32	Senior management strongly support my using the ERP system	1	2	3	4	5	6	7
33	I would like very much to use the ERP system because senior management thinks I should use it	1	2	3	4	5	6	7
	<b>Top Management Support</b>							
34	I felt that they supported the system	1	2	3	4	5	6	7
35	I felt that they were having highly intention to change	1	2	3	4	5	6	7
36	The company promoted the system before implementation	1	2	3	4	5	6	7

37	Our top management supported ERP implementation project well.	1	2	3	4	5	6	7
38	The company provided training courses	1	2	3	4	5	6	7
	<b>Self-efficacy</b>							
39	I feel comfortable with ERP	1	2	3	4	5	6	7
40	I am confident of using the ERP even if there is no one around to show me how to do it	1	2	3	4	5	6	7
41	I am confident of using the ERP even if I have never used such a system before	1	2	3	4	5	6	7
42	I am confident of using the ERP as long as someone shows me how to do it	1	2	3	4	5	6	7
43	I am confident of using the ERP as long as I have a lot of time to complete the job for which the software is provided	1	2	3	4	5	6	7

10- How many time times do you believe you use ERP System per week?

☐ Not at all
 ☐ Less than once a week
 ☐ About once a week

☐ 2-3 times a week
 ☐ Several time
 ☐ week
 ☐ About once a day

☐ Several times each day

11- How many hours do you believe you use ERP System per week?

☐ Not at all

☐ Less than 1 hour a week

☐ 1-3 hours

☐ 3-6 hours

☐ 6- 10 hours

☐ 10- 15 hours

☐ more than 15 hours

**Thank you**

بسم الله الرحمن الرحيم

كلية إدارة الأعمال

جامعة Bolton - بريطانيا

### المشاركين الأعضاء:

أرجوا التكرم بالإجابة على فقرات الاستبيان المرفق والذي هو جزء من رسالة دكتوراه في قسم إدارة الأعمال بجامعة BOLTON – بريطانيا.

يدرس البحث العوامل المؤثرة في تبني نظام تخطيط موارد المؤسسات (ERP) التعليمية في المملكة العربية السعودية.

يتكون هذا الاستبيان من ثلاثة أجزاء وهي: المعلومات الشخصية، العوامل المؤثرة على استخدام نظام ERP ، والاستخدام الفعلي لنظام ERP.

مشاركاتكم المشكورة بالإجابة على هذا الاستبيان ستساعد في تحقيق هدف هذا البحث، فلذلك نرجو منكم الإجابة على جميع فقرات هذا الاستبيان بأقصى دقة ممكنة علماً بأن جميع البيانات سوف تعامل بسرية تامة ولأغراض البحث الأكاديمي فقط.

محمد البرغوثي

[MA15MPO@bolton.ac.uk](mailto:MA15MPO@bolton.ac.uk)

وشكراً جزيلاً لكم

## APPENDIX B: THE ARABIC INSTRUMENT

### الجزء الأول: المعلومات الشخصية

يرجى وضع (x) بجانب الإجابة الصحيحة:

1- الجنس: ☐ ذكر ☐ أنثى

2- عدد سنوات الخبرة في العمل الحالي:

☐ أقل من سنة ☐ 3-1

☐ 6-3 ☐ أكثر من 6 سنوات

3- قسم العمل:

☐ قسم المالية ☐ قسم التسجيل ☐ قسم الموارد البشرية

☐ أخرى .....

4- المستوى التعليمي:

☐ ثانوية او اقل ☐ دبلوم

☐ الدرجة جامعية الاولى ☐ ماجستير او دكتوراة

5- العمر:

☐ اقل من 20 سنة ☐ 20- اقل من 30 سنة

☐ 30- اقل من 40 سنة ☐ 40 سنة فأكثر

6- مكان الإقامة:

☐ الرياض ☐ جدة ☐ الدمام

☐ أخرى.....

7- الحالة الاجتماعية:

☐ أعزب ☐ متزوج ☐ غير ذلك

### الجزء الثاني: العوامل المؤثرة على استخدام نظام ERP

(8) يرجى وضع دائرة حول الرقم المناسب للفقرات التالية حول معتقداتك عن استخدام نظام ERP (حيث 7 تعني اوافق بشدة و1 تعني لا اوافق بشدة)

الرقم	الفقرة	أوافق بشدة	لا أوافق بشدة
1	استخدام ERP يسمح لي بانجاز مهماتي بسرعة اكبر	1 2 3 4 5 6 7	1 2 3 4 5 6 7
2	استخدام ERP يحسن من انجازي في العمل	1 2 3 4 5 6 7	1 2 3 4 5 6 7
3	استخدام ERP يعزز كفاءتي في العمل	1 2 3 4 5 6 7	1 2 3 4 5 6 7
4	استخدام ERP يزيد من إنتاجيتي في العمل	1 2 3 4 5 6 7	1 2 3 4 5 6 7
5	استخدام ERP يسهل عملي	1 2 3 4 5 6 7	1 2 3 4 5 6 7
6	بشكل عام، وجدت ERP مفيد في عملي	1 2 3 4 5 6 7	1 2 3 4 5 6 7
7	تعلم استخدام ERP سهل بالنسبة لي	1 2 3 4 5 6 7	1 2 3 4 5 6 7
8	ان استخدام ERP يمكنني من ان انجز ما اريد بسهولة	1 2 3 4 5 6 7	1 2 3 4 5 6 7



1	2	3	4	5	6	7	9	متطلبات التعامل مع ERP سهلة و مفهومة بالنسبة لي
1	2	3	4	5	6	7	10	الحصول على معلومات من ERP سهل
1	2	3	4	5	6	7	11	انه من السهل أن أصبح ماهرا في استخدام ERP
1	2	3	4	5	6	7	12	بشكل عام، وجدت ERP سهل الاستخدام
1	2	3	4	5	6	7	13	ارغب في استخدام ERP في عملي
1	2	3	4	5	6	7	14	ارغب في استخدام ERP في اعمال اخرى في المستقبل
1	2	3	4	5	6	7	15	ارغب في زيادة استخدامي لنظام ERP في المستقبل
1	2	3	4	5	6	7	16	لأنني استخدم ERP ، سأصحح زملائي في استخدامه
1	2	3	4	5	6	7	17	ERP مهم بالنسبة لي
1	2	3	4	5	6	7	18	استخدام ERP فكرة جيدة
1	2	3	4	5	6	7	19	ERP مزود ببيئة اتصال جيدة
1	2	3	4	5	6	7	20	أحب استخدام ERP
1	2	3	4	5	6	7	21	التدريب على التعامل مع نظام ERP كان كامل
1	2	3	4	5	6	7	22	التدريب على نظام ERP اعطاني ثقة بنفسني للتعامل مع النظام
1	2	3	4	5	6	7	23	المدرّب كان ذا معرفة عالية وساعدني في فهم النظام
1	2	3	4	5	6	7	24	التدريب على التعامل مع نظام ERP كان كافي
1	2	3	4	5	6	7	25	بشكل عام، فهمي لنظام ERP ازداد بشكل واضح بعد التدريب
1	2	3	4	5	6	7	26	التعامل مع الكمبيوتر يجعلني متوترا
1	2	3	4	5	6	7	27	التعامل مع الكمبيوتر يجعلني معقدا
1	2	3	4	5	6	7	28	التعامل مع الكمبيوتر يجعلني غير مرتاحا
1	2	3	4	5	6	7	29	اخاف من استخدام الكمبيوتر
1	2	3	4	5	6	7	30	زملائي يعتقدون انه يجب علي استخدام ERP
1	2	3	4	5	6	7	31	مدرّائي يعتقدون انه يجب علي استخدام ERP
1	2	3	4	5	6	7	32	الادارة العليا تدعم استخدامي لنظام ERP
1	2	3	4	5	6	7	33	انا سوف استخدم نظام ERP لان الادارة العليا تعتقد انه يجب علي استخدام ERP
1	2	3	4	5	6	7	34	اعتقد ان الادارة العليا تدعم استخدام النظام
1	2	3	4	5	6	7	35	اعتقد ان الادارة العليا ترغب في التغيير

1	2	3	4	5	6	7	المؤسسة روجت نظام ERP قبل تطبيقه	36
1	2	3	4	5	6	7	كان دعم الادارة العليا لتطبيق نظام ERP جيدا	37
1	2	3	4	5	6	7	دربت المؤسسة الموظفين على استخدام النظام	38
1	2	3	4	5	6	7	اشعر براحة مع ERP	39
1	2	3	4	5	6	7	اثق بنفسي في استخدام ERP حتى عندما لا يساعدني احد في ذلك	40
1	2	3	4	5	6	7	اثق بنفسي في استخدام ERP حتى لو أني لم استخدم مثل هذا النظام من قبل	41
1	2	3	4	5	6	7	اثق بنفسي في استخدام ERP طالما يوجد احد يساعدني في ذلك	42
1	2	3	4	5	6	7	اثق بنفسي في استخدام ERP طالما املك الوقت الكافي لذلك	43

### الجزء الثالث: الاستخدام الفعلي لنظام ERP

(9) هل تستخدم نظام ERP؟

☐ نعم (اجب سؤال 10 و 11) ☐ لا (شكرا انتهت الاسئلة)

(10) كم مرة تعتقد انك تستخدم ERP في الاسبوع؟

☐ أبدا ☐ اقل من مرة واحدة في الاسبوع

☐ مرة واحدة في الاسبوع ☐ 2-3 مرات في الاسبوع

☐ عدة مرات في الاسبوع ☐ مرة في اليوم

☐ عدة مرات في اليوم

11) كم ساعة تعتقد انك تستخدم ERP في الاسبوع ؟

أبدا ☐ أقل من ساعة واحدة في الأسبوع ☐

3-1 ساعات ☐ 6-3 ساعات ☐

10-6 ساعات ☐ 15-10 ساعة ☐

أكثر من 15 ساعة ☐

وشكرا جزيلا لكم

## APPENDIX C: ANTI-IMAGE CORRELATION

		PU1	PU2	PU3	PU4	PU5	PU6	PEU1	PEU2	PEU3	PEU4	PEU5	PEU6
Anti-image Correlation	PU1	.959 <sup>a</sup>											
	PU2	- .470	.960 <sup>a</sup>										
	PU3	- .107	-.192	.952 <sup>a</sup>									
	PU4	- .069	-.124	-.532	.952 <sup>a</sup>								
	PU5	- .113	-.030	-.042	-.199	.983 <sup>a</sup>							
	PU6	- .055	-.040	-.054	-.121	- .167	.976 <sup>a</sup>						
	PEU1	.004	-.033	.012	-.042	.031 .011	- .011	.955 <sup>a</sup>					
	PEU2	.011	-.023	-.106	.018	- .070	- .138	- .237	.965 <sup>a</sup>				
	PEU3	.125	.058	-.074	.034	- .098	- .095	- .412	-.122	.950 <sup>a</sup>			
	PEU4	- .093	-.056	.149	-.006	- .091	.050	.047	-.280	- .338	.961 <sup>a</sup>		
	PEU5	- .125	.108	-.069	.014	- .005	.045	- .029	-.045	- .220	- .017	.966 <sup>a</sup>	
	PEU6	.070	-.131	.068	-.092	.108	.054	- .022	-.048	- .113	- .184	- .299	.973 <sup>a</sup>
	IU1	- .001	.043	-.012	.082	- .114	- .092	- .001	-.048	.062	- .075	- .046	-.157
	IU2	.046	-.045	.044	-.085	- .037	-.093	.034	.004	- .048	.159	- .046	.000
	IU3	- .039	.023	.010	.010	- .009	- .060	.011	.104	.011	- .109	- .042	.034
	IU4	.001	-.016	-.108	.032	- .007	- .118	- .011	.032	.131	- .056	- .082	-.007
	A1	- .022	.034	.008	-.003	- .047	.012	- .044	.008	.085	- .037	.019	-.008
	A2	.083	-.035	.006	-.037	.023	- .093	- .027	-.019	.043	.032	- .068	.029
	A3	- .077	-.009	-.042	.073	.002	.126	.091	-.014	- .156	- .021	-.087	-.048
	A4	- .104	.111	.038	-.124	- .002	- .164	.068	-.033	- .037	- .028	.081	-.014
	UT1	.011	.000	.119	-.018	- .037	- .031	- .045	-.063	- .036	.125	- .086	.028
	UT2	- .032	-.026	-.090	.031	- .058	.057	.066	.041	- .044	- .098	- .011	-.033
	UT3	.006	.056	.012	.022	.038	- .124	.127	.235	.078	- .196	- .110	.106
	UT4	- .016	.014	-.046	.052	- .052	.061	.090	-.196	- .075	.191	.173	-.143
	UT5	.022	-.068	.103	-.053	.106	- .027	- .070	-.003	.034	- .020	- .024	-.026
	CA1	- .069	.087	-.048	-.095	- .011	.176	- .086	.075	- .006	- .010	-.079	-.055
	CA2	.108	-.072	.057	.002	- .009	- .103	- .015	-.022	.045	- .023	.042	-.006
	CA3	- .029	.002	-.076	.136	- .010	- .015	-.038	-.021	- .002	- .024	- .052	-.030
	CA4	.040	-.073	.003	-.058	.040	.014	.096	-.050	- .057	.034	- .026	.078
	SN1	- .125	.056	-.012	-.003	.026	.045	.060	.051	- .075	- .087	.081	-.002

	SN2	.037	-.023	-.017	.054	-	-	-	.009	.020	-	-	-.016
	SN3	-	.076	-.056	.003	.005	.063	.050	-.076	-	.049	-	.063
		.022								.093		.019	
	SN4	.001	-.013	.064	-.100	.019	-	-	.000	.067	-	-	.020
							.020	.006			.022	.039	
	TMS1	.034	-.104	-.132	.089	.005	-	-	.169	-	-	.097	-.097
							.036	.098		.045	.031		
	TMS2	-	.046	.042	.066	-	-	.066	-.005	-	-	-	.002
		.049				.001	.063			.014	.039	.103	
	TMS3	.039	-.039	-.006	-	.045	.000	.061	-.032	-	.052	.006	.001
					9.688E-06					.092			
	TMS4	-	.027	-.033	.049	-	.083	.016	.018	-	-	.054	-.030
		.070				.033				.029	.034		
	TMS5	.079	-.018	.052	-.066	-	-	-	.015	.152	-	-	.040
						.013	.122	.085			.014	.074	
	CSE1	.017	-.046	.115	-.051	-	-	-	-.055	.096	.041	-	.031
						.168	.054	.088				.061	
	CSE2	.052	-.068	-.012	.026	.027	.040	-	.147	.058	.025	-	-.040
								.146				.100	
	CSE3	-	.120	-	-.031	.099	.034	.042	-.082	-	.010	.010	-.006
		.098		3.132E-06						.105			
	CSE4	.004	-.100	-.130	.149	-	.038	.042	-.026	-	-	.117	.046
						.020				.062	.045		
	CSE5	.039	-.012	.085	-.075	-	-	.047	-.060	.012	-	-	-.046
						.017	.012				.017	.078	

a. Measures of Sampling Adequacy(MSA)

Anti-image Matrices

IU1	IU2	IU3	IU4	A1	A2	A3	A4	UT1	UT2	UT3	UT4	UT5	CA1	CA2	CA3	CA4	SN1	SN2	SN3	SN4
.963 <sup>a</sup>																				
-.466	.947 <sup>a</sup>																			
.037	-.379	.956 <sup>a</sup>																		
-.149	-.012	-.317	.976 <sup>a</sup>																	
.011	.040	-.035	-.055	.839 <sup>a</sup>																
-.069	-.013	.011	.083	-.711	.816 <sup>a</sup>															
.102	-.055	-.016	-.133	-.151	-.534	.862 <sup>a</sup>														
-.016	-.042	-.023	-.084	.014	-.146	.028	.979 <sup>a</sup>													
-.010	.090	-.096	.074	.010	.035	-.066	-.204	.943 <sup>a</sup>												
-.036	-.081	.106	-.022	-.048	.023	-.002	-.013	-.434	.961 <sup>a</sup>											
-.007	-.044	.132	-.062	.082	-.063	-.028	.045	-.073	-.256	.916 <sup>a</sup>										
.091	.028	-.115	-.042	-.066	.030	.077	.009	-.144	-.125	-.468	.906 <sup>a</sup>									
-.083	.027	-.012	.030	-.060	.032	-.024	.044	-.032	.081	-.097	-.392	.942 <sup>a</sup>								
.055	-.057	-.024	-.052	-.027	.035	-.007	-.007	.046	.017	-.055	.041	-.193	.834 <sup>a</sup>							
.032	-.062	.066	-.010	.094	-.065	-.066	.058	-.098	.019	.102	-.057	.022	-.456	.848 <sup>a</sup>						
-.057	.055	-.074	.080	-.046	-.039	.140	-.113	.101	-.068	-.027	.058	-.002	-.308	-.438	.835 <sup>a</sup>					
-.015	.107	.020	-.045	.008	.078	-.115	.086	-.177	.075	-.032	-.043	.103	-.062	-.116	-.401	.879 <sup>a</sup>				
.093	-.127	.090	-.006	-.020	-.062	.062	.072	-.086	.148	-.058	.019	-.184	.272	-.078	-.104	-.126	.888 <sup>a</sup>			
-.062	.033	.079	-.050	-.038	.101	-.089	-.062	.162	-.121	.118	-.032	.026	-.134	.083	.056	.019	-.594	.902 <sup>a</sup>		
.020	.050	-.181	.021	.107	-.176	.119	.055	.044	.047	-.172	.094	-.119	.042	-.009	-.025	-.014	.018	-.343	.895 <sup>a</sup>	
-.006	-.069	.018	.076	-.063	.164	-.121	-.023	-.021	-.047	.033	-.164	.175	.014	-.029	-.051	.024	-.064	-.054	-.441	.908 <sup>a</sup>
-.003	-.047	.050	.003	.005	-.043	.054	-.046	-.197	.108	-.014	.040	.007	.032	-.057	.029	.075	.024	-.055	-.241	-.157
.030	-.037	.021	.063	-.084	.055	-.010	-.034	.140	-.017	.000	-.029	.069	-.108	-.022	.071	-.170	.074	.012	.009	.049
-.011	-.054	-.017	-.001	-.964	.694	.175	-.068	-.021	.054	-.072	.074	.051	.040	-.099	.050	-.010	.003	.021	-.097	.067

.065	.018	-.017	-.090	.712	-.969	.519	.124	-.022	-.030	.032	-.004	-.055	-.036	.052	.050	-.052	.052	-.089	.181	-.158
-.084	.036	.034	.122	.152	.529	-.952	-.089	.058	-.019	.048	-.082	.003	.002	.074	-.124	.089	-.066	.107	-.144	.137
-.085	.026	.120	-.074	-.100	.110	-.044	.064	.005	.013	-.077	-.021	-.028	-.081	.075	.009	-.011	-.078	.052	-.134	.054
-.079	.076	-.128	.025	.054	.085	-.138	-.168	-.087	-.013	.173	-.051	-.064	.070	.043	-.089	.056	-.056	.057	-.159	.083
.116	-.093	.080	-.053	-.008	-.113	.122	.051	.049	-.053	-.011	-.062	.105	-.014	-.034	.020	-.042	.019	-.113	.101	.021
-.063	-.044	-.060	.030	-.024	-.015	.068	-.042	-.054	-.029	-.085	.088	-.034	-.027	.020	.008	-.008	-.007	-.014	.071	-.079
.012	.075	-.097	.005	.035	-.050	.013	.014	.081	-.037	-.037	.028	-.004	-.057	-.009	.081	-.034	-.012	.013	.116	-.158

a.

Measures of Sampling Adequacy (MSA)

### Anti-image Matrices

TMS1	TMS2	TMS3	TMS4	TMS5	CSE1	CSE2	CSE3	CSE4	CSE5
<b>.945a</b>									
-.339	<b>.883a</b>								
.008	.088	<b>.712a</b>							
.022	-.074	-.716	<b>.656a</b>						
-.041	-.003	-.183	-.545	<b>.728a</b>					
-.177	-.005	.080	-.112	.057	<b>.966a</b>				
-.020	-.082	-.040	-.066	.143	-.301	<b>.939a</b>			
.040	.038	-.006	.086	-.132	-.048	-.479	<b>.949a</b>		
.138	-.114	.028	.033	-.073	-.122	-.031	-.115	<b>.956a</b>	
-.085	.061	-.030	.032	-.007	.064	-.149	-.204	-.438	<b>.958a</b>

a. Measures of Sampling Adequacy (MSA)